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# Conodonts from the lowermost Ordovician strata of South-Central Sweden

By

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## I. Introduction

That there are conodonts in the Lower Ordovician of Sweden has been known since the beginning of this century (see i. a. WIMAN 1903, WESTERGÅRD 1909, HEDE 1951).

The original intentions with this study were to investigate the occurrence of conodonts in a stratigraphically interesting part of the Lower Ordovician sequence in South-Central Sweden and to try to make stratigraphic use of conodonts. When the conodont faunas proved to be not only rich but also well preserved, the scope of the study was slightly widened to include the nature of conodonts and conodont classification.

In the course of the study I have had to disagree on different questions with several other conodont workers, past and present. I am very much aware that in several of these cases, the other point of view s highly defendable, however, my points of view seem to me the best olutions of the problems that arise from my conodont material.

35—*540060. G. F. F. 1954.*

It is my pleasant duty to thank Dr Fritz Brotzen for directing my attention to conodonts. The work was carried out at the Institute of Paleontology of the Lund University. To its director, Professor Gustaf T. Troedsson I wish to direct special thanks for his friendly advice and generous help without which the work could never have been done. Docent Gerhard Regnéll has read the chapter on conodont classification and given much helpful criticism. Docent Georg Wingstrand and Dr. phil. Tor Ørvig have given me essential help with the chapter on the nature of conodonts. It must be emphasized that none of these gentlemen is, however, responsible for the lines of reasoning here adopted.

## II. Methods of study

Sampling. To get well dated conodont faunas, samples were taken at three thoroughly investigated sections, viz. Änga at Stora Backor in Västergötland (Thorslund 1937) and Lanna and Latorp in Närke (Tjernvik 1952). The other sections were chosen at random among the good sections through the Lower Ordovician available in South-Central Sweden. The intervals between the samples was strongly varied, partly to investigate what intervals give the best results. At the bases of the sections every decimeter was sampled. In conglomeratic and coarse-grained strata the sampling was also very close. As a rule every lithologic unit was sampled. Sampling with even intervals does not seem advisable.

Reducing the samples. The first stage in all the cases was crushing the samples to fragments about the size of a walnut. Although this was done with a hammer in an iron tray, the blows seem not to have been very damaging to the micro-fossils. Still, I believe that crushing by pressure is the best, where it can be done. If histologic sectioning of the material is to be done, crushing the samples by hammer is certainly not to be recommended.

The limestones were dissolved in 25 % acetic acid. About 150 g of rock were used in all the cases. The residual mud went through a 0.25 mm screen under running water. What remained in the screen was searched for conodonts.

The shales were first treated by the Campbell method (Campbell & Hussey 1951). This method left the conodonts as worn as even the glauconite. I attribute this to the abundance of pyrite.

After the failure with the Campbell method they were treated by boiling in over-saturated solution of Glauber's salt and subsequent cooling off (Wicher 1942, p. 15). In this way they were not reduced to mud but after 3—10 boilings had been broken down to very small, tabular grains. The conodonts were largely left free, but in a very broken state. As a rule they were determinable. Treatment with hydrogen peroxide (Wick 1947) was entirely unsuccessful.

Extracting the conodonts. In the majority of the samples glauconite and (or) pyrite played a dominant rôle in the residues. This meant that separation of the conodonts by heavy liquids generally was unsuccessful. On the other hand, conodonts as a rule were so common that it was worth while to examine the residues piecemeal under a binocular microscope and pick the conodonts out by a very fine camel's hair brush. In the samples with abundant and typical conodont faunas only about 1/3 of the residue was searched for conodonts. In very rich faunas, I tended to neglect the bad specimens. To check the amount of unreliability introduced by such choice, I made separate extractions from the samples of Bjällum at different occasions and kept the different faunal samples from the same rock samples apart.

Nomenclature. Some of the terms used in conodont litterature are illustrated in textfig. 1. Those used in this work are underlined. Designations like anterior, posterior, oral and aboral are hard to defend except by stating that they are used in all recent litterature and it is very difficult to find good substitutions for them. I have chosen to let the anterior process (or anticusp) and the lateral processes rank as high as the 'oral bar' and call all of them processes. Also, uniformity of nomenclature between the simple and compound forms has seemed to be desirable, as far as possible. All the forms are oriented with the basal stretch of the concave margin horizontal. This stretch is called oral margin. In relation to the oral margin the apical portion of the tooth, i. e. the cusp, is proclined, erect, reclined or recurved, as defined by fig. 1. This relation has proved significant in the faunas here dealt with.

'Curved', unless otherwise indicated, is used for outline curvatures observable in lateral view, 'rounded' for convex outline curvature of the cross section. 'Inner' and 'outer' are applied conditionally to distinguish the lateral faces. The inner face as a rule is the one towards which the cusp is bent in slightly unsymmetrical conodonts. 'Width' of the cusp, unless otherwise indicated, is the relative distance between the anterior and posterior margins, 'thickness' that between the lateral faces. The terms 'inverted basal cavity' and 'basal canalules' are treated under chapter V.

Illustrations. Stauffer's great success with drawings to represent his specimens led me to adopt the same mode of illustration in my plates. The specimens were not whitened by $NH_4Cl$, so their natural transparency should be apparent. As a rule, the basal cavity is evident. Since the specimens were mounted on a black background, the specimens that appear white in the drawings are among the least transparent. The drawings were done by Abbé's apparatus, and no reconstructions of lost parts were made.

Table of occurrence. After the material had been worked through from a systematic point of view, the number of specimens from each sample belonging to each species represented was counted, mostly in order to find out whether there were any constant proportions between certain kinds of conodonts. From this point of view, the result was not encouraging. Since the figures arrived at are rather illuminating from a stratigraphic point of view, they are still rendered in the table. It must be emphasized that relative abundance of conodonts between the samples appears from the table but in a very approximate way, the portions of the different samples examined for conodonts being unequal. Where few specimens are reported, the whole of the sample has, however, as a rule been searched through. The control conodonts from the Bjällum samples were counted as well, and are also tabulated. In the table, the species are arranged in four groups, according to the strata in which they first occur, or, in a few cases, the strata in which they are first well represented. Within the groups, the genera and species are listed alphabetically.

The originals of the figures are kept at the Institute of Paleontology of the Lund University.

## III. Localities and samples

The levels are given in meters above the Cambro-Ordovician discontinuity. For the sections, see pl. 8.

Änga quarry, Stora Backor. Situated at the NW end of Mösseberg, 2 200 m NE of Vilske Kleva church, at the figure 207,3 (topogr. map 1 : 100 000, sheet 43, Skara). The quarry at present is disused. The section described by THORSLUND (1937, p. 146—151) is available in the E wall of the quarry.

Sample 1. 0,10—0,13. Blackish brown anthraconite ('stinkstone') banded with alum shale. No fossils. No glauconite. Pyrite as little lenses and bands. *No conodonts found.*

Sample 2. 0,15—0,17. Glauconite sandstone with slightly carbonatic matrix. Small brown spheres like the 'egg cases?' of STAUFFER (1935 b, pl. 75, figs. 54—56), in the following referred to as 'egg cases'. Glauconite grains coarse, shattered. Pyrite sparse. No quartz grains observed. Small pieces of coal. Phosphorite granules.

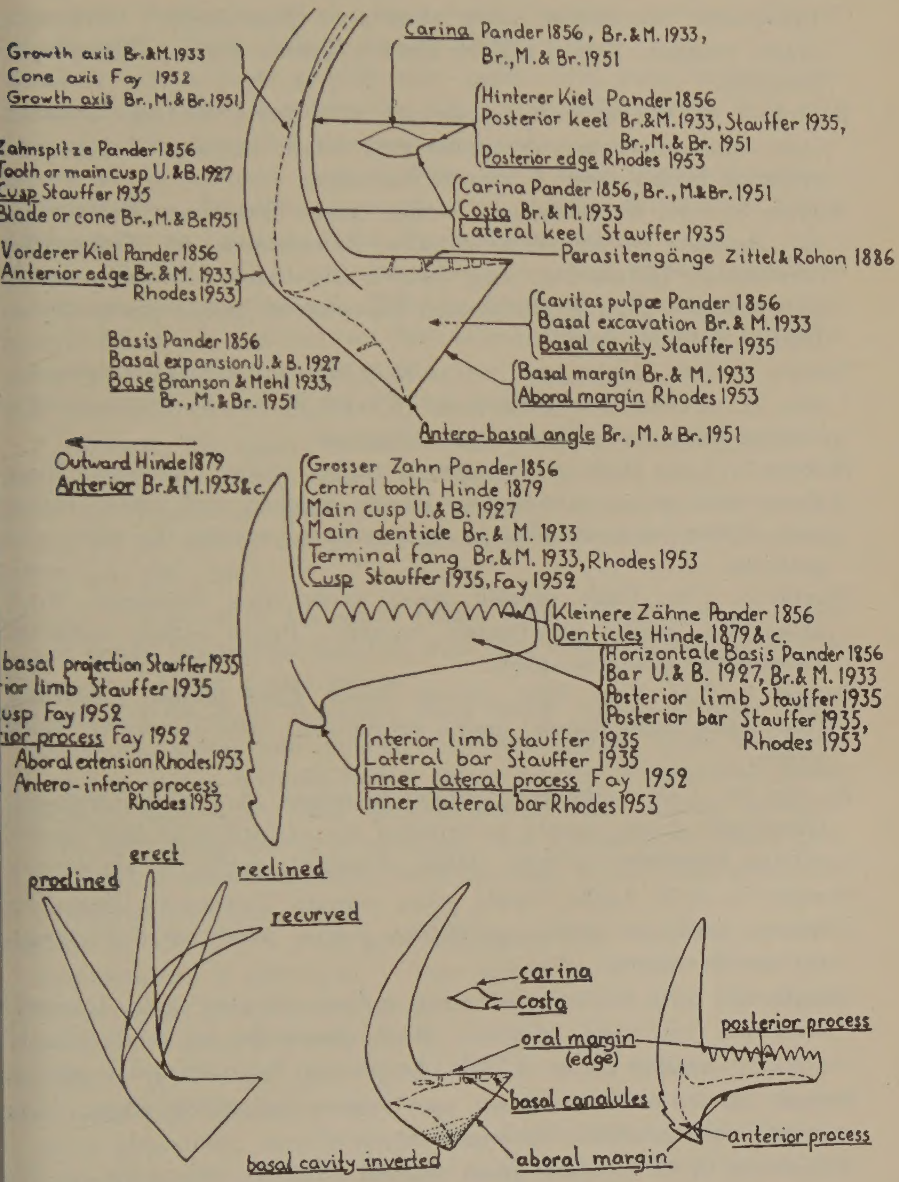

Carina Pander 1856, Br.&M. 1933, Br.,M.& Br. 1951
Growth axis Br.&M. 1933
Cone axis Fay 1952
Growth axis Br.,M.& Br. 1951
Hinterer Kiel Pander 1856
Posterior keel Br.&M. 1933, Stauffer 1935, Br.,M.& Br. 1951
Posterior edge Rhodes 1953
Zahnspitze Pander 1856
Tooth or main cusp U.&B. 1927
Cusp Stauffer 1935
Blade or cone Br.,M.& Br. 1951
Carina Pander 1856, Br.,M.& Br. 1951
Costa Br.& M. 1933
Lateral keel Stauffer 1935
Vorderer Kiel Pander 1856
Anterior edge Br.& M. 1933, Rhodes 1953
Parasitengänge Zittel & Rohon 1886
Cavitas pulpae Pander 1856
Basal excavation Br.& M. 1933
Basal cavity Stauffer 1935
Basis Pander 1856
Basal expansion U.& B. 1927
Base Branson & Mehl 1933, Br.,M.& Br. 1951
Basal margin Br.& M. 1933
Aboral margin Rhodes 1953
Antero-basal angle Br.,M.& Br. 1951
Outward Hinde 1879
Anterior Br.& M. 1933 & c.
Grosser Zahn Pander 1856
Central tooth Hinde 1879
Main cusp U.& B. 1927
Main denticle Br.& M. 1933
Terminal fang Br.& M. 1933, Rhodes 1953
Cusp Stauffer 1935, Fay 1952
Kleinere Zähne Pander 1856
Denticles Hinde 1879 & c.
Horizontale Basis Pander 1856
Bar U.& B. 1927, Br.& M. 1933
Posterior limb Stauffer 1935
Posterior bar Stauffer 1935, Rhodes 1953
basal projection Stauffer 1935
ior limb Stauffer 1935
usp Fay 1952
ior process Fay 1952
Aboral extension Rhodes 1953
Antero-inferior process Rhodes 1953
Interior limb Stauffer 1935
Lateral bar Stauffer 1935
Inner lateral process Fay 1952
Inner lateral bar Rhodes 1953
erect
proclined
reclined
recurved
carina
costa
oral margin (edge)
posterior process
basal canalules
anterior process
basal cavity inverted
aboral margin

Fig. 1. Conodont terminology. Terms used in this study underlined.

Sample 3. 0,23—0,26. Glauconite sandstone with carbonatic matrix. Phosphatic brachiopod shells abundant. 'Egg cases'. Glauconite grains angular. Pyrite almost absent. Quartz grains? Phosphorite granules.

Sample 4. 0,45. Glauconite sandstone with clayey matrix. Acrotretacea common. Glauconite grains very small, angular. Coal as subspherical lumps about 5 mm in diameter.

Sample 5. 1,15. Greenish grey rather coarse limestone. *Helmersenia* sp., *Acrothele barbata* MOBERG a. o. Acrotretacea, cf. *Archaeorthis christianiae* (KJERULF), 'egg cases'. Glauconite grains rounded, partly rather pale. Pyrite sparse. Subrounded quartz grains. Phosphorite granules sparse.

Sample 6. 1,35. Light grey, rather fine, impure limestone. Acrotretacea, cf. *Archaeorthis christianiae* (KJERULF). Glauconite as a thin coating on some surfaces. Pyrite common.

Sample 7. 1,40. Dark greyish green, rather coarse limestone. Much glauconite, grains subrounded, lobate, cracked and partly rather pale. Pyrite common, often in aggregates, or coating the glauconite granules.

Sample 8. 1,55. Dark greyish green, rather fine limestone. Much glauconite, grains subrounded, cracked. Pyrite rather common. Phosphorite granules sparse.

Sample 9. 1,75. Very light greyish green, fine, impure limestone. Glauconite rather sparse, grains subrounded, partly cracked. Some pyrite.

Sample 10. 1,85. Light grey impure limestone. A few Acrotretacea. Glauconite sparse, partly as rounded grains, partly as light green, spongy structures. Pyrite rather abundant, partly in aggregates.

Sample 11. 2,05. Light bluish green impure limestone. Glauconite sparse, partly as coarse, polylobate grains, partly as light green, spongy structures.

Sample 12. 2,10. Dark greyish green or brownish grey shale. Acrotretacea and 'egg cases' common. Much glauconite, as small, closely crowded, angular grains. A little phosphorite. Rounded quartz grains.

Sample 13. 3,15. Light bluish grey—green indurated shale. 'Egg cases'. Coal granules. *No conodonts found.*

Sample 14. 4,15. Greyish green indurated shale. Some pyrite. *No conodonts found.*

Sample 15. 4,35. Light greyish blue—green, fine, hard, impure limestone. Glauconite grains sparse, partly light and spongy. Rather much pyrite.

Sample 16. 4,45. Light greyish green shale with brownish-black speckles. Much glauconite, grains small, angular, crowded. Rather much pyrite. Some phosphorite granules.

Sample 17. 4,90. Light greyish blue—green, fine, hard, impure limestone. 'Egg cases', Acrotretacea. Little glauconite, mostly light and spongy. A little pyrite. *No conodonts found.*

Sample 18. 5,00. Light greenish blue—grey, fine, impure limestone. Acrotretacea. Trilobite fragments with random orientation. Little glauconite, as small granules. Pyrite aggregates.

Sample 19. c 6,0. Light greenish blue—grey, fine, impure limestone. Atrotretacea. An Orthoid. Trilobite fragments. Pyrite aggregates.

Sample 20. c 7,0. Light brown, fine, impure limestone. Some beautiful Acrotretacea. Trilobite fragments.

The samples 19 and 20 are left out in the section, pl. 8.

Tomten. Big quarry situated 7 km NNE of Falköping, 1 700 m N by E of Torbjörnstorp church, at 'Kalkbr.' (topogr. map 1 : 100 000, sheet 43, Skara). The quarry is worked. My section is from the NE corner of the quarry and is not identical with that of THORSLUND (1937, pp. 155—156).

Sample 1. 0,00—0,08. Chocolate brown shale with glauconitic lenses and bands. Glauconite rounded, with faint cracks. Some phosphorite granules. A few quartz grains.

Sample 2. 0,08—0,10. Brownish black shale. Calcite crystals. Much glauconite, grains well rounded with faint cracks. Pyrite dominates and has largely replaced former calcite matrix. *No conodonts found.*

Sample 3. 0,10—0,16. Dark greyish green, fine, impure limestone with light green and grey speckles. Fine Acrotretacea. Much glauconite, big grains, rounded, little cracked. Pyrite common. Small phosphorite pebbles.

Sample 4. 0,16—0,18. Dark greenish grey, fine, impure limestone. Acrotretacea. A gastropod. *Nileus armadillo* (DALM.). Much glauconite partly as light, spongy grains. Pyrite common. Phosphorite granules. Rounded quartz grains.

Sample 5. 0,18—0,21. Dark grey, rather fine, impure limestone. Acrotretacea. Orthacea (with the convexity downwards). Rather much glauconite, mostly rounded grains without cracks, but also light green, spongy grains. Rather much pyrite, often in aggregates. Phosphorite granules. Quartz granules.

Sample 6. 0,30—0,33. Greenish grey, fine, impure limestone. 'Egg cases' (cf. Stora Backor, sample 2). Many Acrotretacea. Glauconite common, mostly angular grains. Pyrite common, often in aggregates.

Sample 7. 0,41—0,44. Grey, rather fine, impure limestone. Beautiful Acrotretacea. Glauconite common, as angular grains, or spongy, coating the bedding-planes. Pyrite common, often in aggregates. Phosphorite grains. Quartz granules.

Sample 8. 0,44—0,46. Grey, rather fine, impure limestone. Acrotretacea. Glauconite common, small rounded, or angular grains. Much pyrite, especially on some bedding-planes.

Sample 9. 0,50—0,55. Greenish grey, rather fine, impure limestone. Some Acrotretacea. Glauconite common, grains cracked or angular. Some pyrite. A few rounded quartz grains.

Sample 10. 1,60. Left out on pl. 8. Light grey, fine, impure limestone. Some Actotretacea. Trilobite fragments abundant. Little glauconite. Pyrite common, in microcrystalline aggregates.

Bjällum. Big quarry situated at the SW corner of Billingen, 500 m E by S of Bjällum hpl., W of the road (topogr. map 1 : 100 000, sheet 43, Skara). The locality is mentioned by WESTERGÅRD (1928, p. 41). My section is from the NW end of the quarry.

Sample 1. 0,00—0,02. Brownish grey, rather fine, impure limestone. Rather much glauconite, partly angular. Pyrite aggregates. Some phosphorite grains.

Sample 2. 0,02—0,04. Dark brownish grey, rather fine, impure limestone. Acrotretacea. Rather much glauconite, partly tabular grains, partly rounded and cracked. Little pyrite. Phosphorite pebbles with included glauconite grains. Very thin coal bands.

Sample 3. 0,04—0,07. Brownish grey shale. Phosphatic brachiopods. Much glauconite, partly rounded, partly cracked, partly angular. Pyrite sparse, yet in a few rather big aggregates. A thin coal lamina.

Sample 4. 0,22—0,27. Light grey, fine, hard, impure limestone. Acrotretacea rather common. Trilobite fragments. Little glauconite. Rather much microcrystalline pyrite.

Sample 5. 0,39—0,45. Greyish green, rather fine, hard, impure limestone. Acrotretacea common. Much glauconite, grains lobate, cracked, somewhat angular. Pyrite in microcrystalline aggregates.

Sample 6. 0,54—0,58. Dark greenish grey, fine, impure limestone. Acrotretacea. Much glauconite, grains angular and cracked. Pyrite common. Some phosphorite grains.

Sample 7. c 1,10. Left out on pl. 8. Light bluish—grey, fine, hard, impure limestone, mottled brownish-grey. Acrotretacea. Trilobite fragments. Rather much pyrite.

Ulunda. Quarry half-way between Skara and Skövde, 500 m S of Varnhem church (topogr. map 1 : 100 000, sheet 43, Skara). The ocality is mentioned by WESTERGÅRD (1928, p. 41). The quarry at resent contains two deeper parts sunk down into the Cambrian alum hales and, surrounding these, a platform that marks the base of the )rdovician so-called Didymograptus Shale. My section is just S of he point where a little railway descends from the NW into the S of the wo deeper parts.

ample 1. 0,0—0,1. Dark greenish grey, rather coarse limestone passing downwards into blackish brown shale with calcite crystals. 'Egg cases' (cf. St. Backor, sample 2). Much glauconite, grains rounded and cracked. Some phosphorite pebbles.

ample 2. 0,1—0,2. Dark greenish grey, rather coarse, impure limestone with lighter spots. Beautiful Acrotretacea. Much glauconite, grains tabular, cracked. Pyrite sparse. Some phosphorite grains.

ample 3. 0,2—0,3. Grey, rather fine limestone. Acrotretacea rather common. Orthacea. Not much glauconite, chiefly as coating of burrows, somewhat spongy, but also small flat grains. Pyrite rather sparse.

ample 4. 0,3—0,4. Brownish grey, rather fine, impure limestone. Some Acrotretacea. Glauconite sparse, grains small, angular. Pyrite sparse, in microcrystalline aggregates.

ample 5. 0,4—0,43. Dark brownish grey, rather fine, impure limestone. Some Acrotretacea. Much glauconite, angular, cracked. Pyrite sparse, mostly in aggregates. On both sides of the bed there is a coal lamina. This lamina is set through with perpendicular and horizontal calcite veins that are also observable in the limestone. Also, there are patches of coal in the limestone.

ample 6. 0,75. Light greyish green shale. 'Egg cases'. A few Atremata. Little glauconite. Rather much pyrite. No conodonts found.

ample 7. 1,0. Light grey, banded, fine, hard, impure limestone. Acrotretacea rather common. Rather much pyrite. Small flakes of clay.

ample 8. 1,1. Silt with quartz-sand. No conodonts found.

ample 9. 1,2. Light greenish grey, rather fine, impure limestone with patches of bluish green marl. Acrotretacea rather common. A good deal of angular glauconite. Pyrite sparse.

ample 10. 3,7. Light greyish blue—green, fine, hard, impure limestone. A few Acrotretacea. Pyrite common. Subrounded quartz-grains.

Skultorp. Disused quarry 6 km S of Skövde, 1 200 m S by W f N. Kyrketorp church, to the E of the road (topogr. map 1 : 100 000, heet 43, Skara). The locality is mentioned by WESTERGÅRD (1928, pp. 9, 42). My section is from the S wall of the big N qauarry.

Sample 1. 0,05—0,08. Greenish grey, rather fine, impure limestone with darker burrows. Acrotretacea. Much glauconite, grains rounded or angular. Much pyrite, mostly in aggregates.

Sample 2. 0,12—0,20. Light grey, fine, rather hard, impure limestone with light green lamellae. Some Acrotretacea. Glauconite rather common, mostly light green and spongy. Rather much pyrite.

Sample 3. 0,20—0,25. Light grey, fine, impure limestone, mottled green and greyish-brown. Some Acrotretacea. Trilobite fragments. Glauconite common, mostly angular or light green, spongy. Pyrite sparse, mostly in microcrystalline aggregates.

Sample 4. 0,62—0,68. Dark grey, fine, impure limestone with green spots. Some Acrotretacea. *Niobe* sp. aff. *obsoleta* LINNARSSON. Glauconite as angular grains or light green, spongy. Pyrite common, in rather big spherical aggregates.

Sample 5. 1,05. Light grey, fine, impure limestone. Many Acrotretacea. Glauconite sparse, grains small. Pyrite rather sparse.

Sample 6. 1,45. Light bluish grey, fine, impure limestone. Acrotretacea rare. Glauconite rare, spongy. Much pyrite, microcrystalline.

Sample 7. 1,60. Light bluish green—grey, fine, impure limestone. Acrotretacea common. Glauconite common, mostly as small granules.

Lanna. Disused quarry 15 km WSW of Örebro, 600 m NW of Lannabruk hpl. (topogr. map 1 : 100 000, sheet 64, Askersund). The locality is described by TJERNVIK (1952, pp. 53—61). My section is at the NE end of the quarry and seems to be identical with that of TJERNVIK.

Sample 1. 0,00—0,05. Greenish grey, fine, partly rather pure limestone. Acrotretacea. Much glauconite, grains rounded, with shallow cracks, partly with a light green, spongy cover. Little pyrite. A few phosphorite pebbles.

Sample 2. 0,10. Greyish green, rather fine, impure limestone. A few Acrotretacea. Orthacea with random orientation. Much glauconite, grains partly angular. Pyrite sparse, partly in aggregates. Phosphorite grains. Few quartz grains.

Sample 3. 0,20—0,30. Grey, rather fine limestone with greyish green, rather coarse parts. A few Acrotretacea. Much glauconite, grains mostly angular or spongy. Pyrite sparse.

Sample 4. 0,50. Light bluish grey—green marl. 'Egg cases', Acrotretacea, Orthacea, trilobite fragments. Little glauconite. Pyrite common. Calcite crystals. No conodonts found.

Sample 5. 0,80. Greenish grey, rather fine, highly impure limestone. Phosphatic brachiopods abundant, Orthacea, trilobite fragments. Glauconite common, spongy. Pyrite common, partly in aggregates.

Sample 6. 1,20. Grey, fine, marly limestone with green bedding-planes. Acrotretacea rather common. Some glauconite, spongy and very pale, or very small grains. Much pyrite, fine, evenly dispersed.

Sample 7. 1,50. Light bluish grey green, rather fine, marly limestone. Acrotretacea. *Megalaspis planilimbata* Ang., *Niobe emarginula* Ang., tracks. Pyrite sparse.

Sample 8. 1,80. Light grey, fine, impure limestone. Acrotretacea. Rather much pyrite.

Sample 9. 2,10. Light greyish blue green, fine, hard, impure limestone. Acrotretacea rather common. Rather much pyrite, partly in small aggregates.

Sample 10. c 2,4. Light greenish grey, rather fine, impure limestone, mottled green. A few Acrotretacea. Some light green, spongy glauconite. Much pyrite.

Sample 11. c 2,7. Light grey, fine, impure limestone, mottled greyish green. Acrotretacea common. Rather much pyrite, often in aggregates.

Sample 12. c 3,0. Light grey, fine, impure limestone with green bedding-planes. Acrotretacea common. *Nileus armadillo* Dalm. Some glauconite, light green, spongy. Much pyrite, often in aggregates.

The samples 10—12 are left out in the section, pl. 8.

Latorp. Disused quarry 12 km W of Örebro, 600 m NNW of atorpsbruk stn. (topogr. map 1 : 100 000, sheet 72, Nora). The locality s described by Tjernvik (1952, pp. 61—63). My section is at the E nd of the S wall of the quarry, and is identical with that of Tjernvik.

ample 1. 0,00 -0,10. Greenish grey, rather coarse limestone. Acrotretacea. *Archaeorthis?* sp. Very much glauconite, grains big, rounded, partly lobate and cracked. Pyrite sparse, often in aggregates. Phosphorite pebbles small, with glauconite inclusions, or with a thin coating of coal. Quartz grains rounded.

ample 2. 0,10 0,14. Greenish grey, rather coarse limestone with bands of brownish green clay. A few Acrotretacea. Much glauconite, grains rounded or angular, cracked. Little pyrite. A few phosphorite grains.

ample 3. 0,42. Greenish grey, fine, marly limestone. Acrotretacea rather common. *Nileus armadillo* Dalm. Some pyrite.

ample 4. 0,42—0,45. Light greyish green marlstone. *Megalaspis planilimbata* Ang., *Niobe* sp. (aff. *obsoleta* Linnarsson) Tjernvik, 1952. Glauconite rare, grains small. Pyrite sparse.

ample 5. 0,45. Light greyish, brownish and greenish mottled, rather fine, impure limestone. Phosphatic brachiopods rather common.

*Megalaspis planilimbata* Ang., *Niobe emarginula* Ang. Glauconite sparse, angular. Much pyrite, often in aggregates.

Sample 6. 0,75. Light greyish green, rather fine, impure limestone. *Megalaspis planilimbata* Ang. Glauconite rather sparse, angular or spongy. Pyrite sparse.

Sample 7. 1,05. Light grey, rather fine, impure limestone with green bedding-planes. Acrotretacea. Glauconite common, mostly spongy. Pyrite sparse.

Yxhult. Big quarry 5 km ESE of Kumla, the S quarry of Yxhults Stenhuggeri AB, situated less than 1 km SSW of the main office at Hällabrottet, at the end of a new road (not marked on topogr. map 1 : 100 000, sheet 65, Vingåker). My sections are from the SW shallow corner of the quarry, I from the W wall and II from the S wall. The quarry is extensively worked, so the sections are probably no more available.

Section I.

Sample 1. 0,00—0,04. Dark greyish brown—green shale. *Archaeorthis* cf. *wimani* (Walc.). Glauconite dominates, grains rounded, more or less cracked. Pyrite sparse. Rather much phosphorite, pebbles small, angular, partly glauconitic.

Sample 2. 0,12. Dark green glauconite sandstone with clayey matrix and bands of brown clay. Orthoid brachiopods abundant. Glauconite grains rounded and craked. Pyrite aggregates rather common. Small phosphorite pebbles.

Sample 3. 0,25. Grey, rather coarse limestone with bands of greenish shale and glauconite sandstone. Rather much glauconite, rounded, cracked. Rather much pyrite, often as lamellar aggregates on the bedding-planes. Some phosphorite grains.

Sample 4. 0,46—0,50. Light bluish green shale. Acrotretacea and Orthoids abundant. Trilobite fragments. All with random orientation. Glauconite common, mostly angular, cracked. Pyrite rather common, often in aggregates. Calcite crystals.

Section II.

Sample 1. 0,00 —0,05. Brownish grey shale with thin limestone lenses. Orthoids abundant, with random orientation. Much glauconite, rounded or angular, craked. Pyrite sparse.

Sample 2. 0,05 —0,08. Brownish grey, coarse, impure limestone. Little glauconite, grains small, angular. Some microcrystalline, irregular pyrite aggregates. Phosphorite? No conodonts found.

Sample 3. 0,17—0,20. Greenish grey, rather fine limestone. A few Acrotretacea. Much glauconite, rounded and cracked. Little pyrite, mostly in aggregates. Some phosphorite. An at least 7 cm wide pebble of anthraconite, weathered grey, with a thin glauconite zone along the margins, and containing i. a. *Sphaerophthalmus* cf. *alatus* (BOECK). (The anthraconite just below the Cambro-Ordovician discontinuity at this locality contains *Ctenopyge affinis* WESTERGÅRD and *Peltura minor* /BRÖGGER/).

Sample 4. 0,30—0,35. Greyish green, rather fine, impure limestone. Acrotretacea. Orthoids. Trilobite fragments. Glauconite plentiful, rounded and cracked, or spongy. Rather much pyrite.

Sample 5. 0,39—0,44. Light greenish grey, rather fine, impure limestone with green bedding-planes. A few Acrotretacea. Glauconite common, angular or spongy. Pyrite sparse.

Sample 6. 0,70—0,75. Light grey or greenish grey, rather coarse, impure limestone. Acrotretacea rare. Orthoids. Trilobite fragments with random orientation. *Megalaspis planilimbata* ANG., earlier form (TJERNVIK 1952, p. 57, fig. 3 A). Glauconite sparse, spongy. Pyrite rare.

Sample 7. 0,85—0,90. Light grey, rather coarse, rather pure limestone with green bedding-planes. Acrotretacea abundant. Orthoids. Glauconite common, light green, spongy. Rather much pyrite, commonly in aggregates.

Sample 8. 1,29—1,34. Light brownish grey, rather fine, impure limestone, mottled greenish grey. Few Acrotretacea. Rather much pyrite, partly in aggregates.

Sample 9. 1,77—1,83. Bluish green marl. *Tetradella* sp. rather common. A little pyrite, in small aggregates.

Sample 10. 2,20—2,25. Bluish grey—green marlstone. Acrotretacea rare. *Megalaspis planilimbata* ANG., younger form (TJERNVIK 1952, p. 57, fig. 3 B). *Tetradella?* sp. Pyrite rather sparse.

Comments on the samples. One of the samples consists f anthraconite and one of unconsolidated sandy silt. In neither of hese were conodonts found. The latter will be given special treatment lsewhere. Fourteen samples can be classed as shale. Of these, five did ot yield any conodonts. The rest of the samples are regarded as limetones and could be treated with dilute acetic acid. Two of these failed o yield any conodonts.

The samples are derived from a series of alternating shales and limetones. The shales are brownish or bluish, but never black. The limetones have varying shades of grey. None of them is derived from a red acies. The bulk of the samples are rich either in glauconite or pyrite, r both. Organic remains are abundant.

The rock sequences must have been deposited in turbulent waters. The grain size in the glauconite sandstones is around 1 mm, and some quartz grains are even bigger. All the brachiopod shells are disconnected. Almost nowhere is the convex side of the shells predominantly downwards. The big anthraconite pebble in the middle of a rather fine limestone bed at Yxhult, section II, sample 3 is noteworthy in this connection. Also, one should be aware of that the distance between the sections I and II of Yxhult is no 30 meters.

## IV. Stratigraphy

The lowermost Ordovician strata of Sweden can be divided into Dictyonema Shales (at the bottom) and Ceratopyge Shales and Limestones (see, e. g., HEDE 1951, Table 5, p. 71). They correspond to the Tremadocian of the Welsh Borderland. Next above are the lowest strata of the Asaphus Series. At the boundary between the Tremadocian and what might correspond to the Arenigian is the zone of *Megalaspis planilimbata* ANGELIN that is followed upwards by the zone of *Megalaspis limbata* (SARS & BOECK). The zone of *Megalaspis planilimbata* has, in turn, been subdivided by TJERNVIK (1952) into a lower subzone that may be Tremadocian and an upper subzone that is connected with the zone of *Megalaspis limbata*. Instead of the full zone names the following denominations are often used. L. and U. Planilimbata Limestone, Limbata Limestone.

The correlation of the strata at Stora Backor was done by THORSLUND in 1937. I have kept his zonal boundaries in the section. pl. 7. In the stinkstone at the bottom of the section. my sample 1. he found *Dictyonema flabelliforme* EICHW. f. typica. whereas no fossils could be found in my sample. The difference between his faunas from the upper part of the sequence designated *Ceratopyge forficula* zone and the lower part of the zone of *Megalaspis planilimbata* is chiefly that the latter does not contain *Ceratopyge forficula* and the former not *Megalaspis planilimbata*. In other respects, the faunas are similar. Both of them characterize the zone of *Apatocephalus serratus* SARS & BOECK in the sense of MOBERG & SEGERBERG (1906, pp. 50, 110), i. e., the uppermost part of the Tremadocian. In the so-called Lower Didymograptus Shale of the upper part of the Planilimbata zone he found i. a. *Phyllograptus densus* TÖRNQUIST.

At Tomten, THORSLUND (1937, pp. 155, 156) with certainty identified Planilimbata and Limbata Limestone. My section is different from his.

At Bjällum, WESTERGÅRD (1928, p. 41) mentions the existence of L. Didymograptus Shale of 0.3 m thickness.

From the Ulunda quarry WESTERGÅRD (1922, p. 64) reports 0,3—

),6 meters of glauconitic limestone with phosphorite nodules to rest on he Cambrian, above that 0,6—0,7 meters of L. Didymograptus Shale vith a thin limestone bed, and above that Orthoceras Limestone. He eems to regard the glauconitic limestone as belonging to the Cera-opyge Limestone, for in 1928 (p. 40) it is mentioned in that connection. At the same time (1928, pp. 38, 39) doubt is expressed as to whether ll the phosphoritic glauconitic limestones immediately above the 'ambro-Ordovician discontinuity do really belong to the *Ceratopyge orficula* zone, determinable fossils being mostly absent.

At Skultorp, Westergård (1928, p. 42) proved that at least the ippermost stratum of the about 0.9 meters thick limestone imme-liately above the Cambrian does belong to the Planilimbata zone. He ists *Megalaspides dalecarlicus* (Holm) together with *Symphysurus bre-viceps* Ang., *Shumardia* (*nericiensis* Wiman?) and *Trinodus glabratus* Ang.). In the L. Didymograptus Shale following thereupon he found he same fauna, except the *Shumardia*.

Lanna and Latorp are the localities on which Tjernvik (1952) hiefly founds his worked-out bipartition of the Planilimbata Lime-tone. The L. Planilimbata Limestone rests directly on the Cambrian, ossibly with a thin basal stratum at Latorp representing the *Ceratopyge orficula* zone. It is about 1 m thick and characterized i. a. by an earlier orm of *Megalaspis planilimbata*, by *Symphysurus breviceps* and *Niobe* p. (aff. *obsoleta* Linnarsson). *Megalaspides dalecarlicus*, on the other and, here begins in the U. Planilimbata Limestone where it is found ogether with i. a. *Niobe* sp. (aff. *laeviceps* /Dalman/) and a younger orm of *Megalaspis planilimbata*. The U. Planilimbata Limestone is bout 2 m thick.

The S quarry of Yxhult has not been described before.

A strong objection against stratigraphic use of conodonts in layers leposited under as turbulent conditions as were obviously ruling here s that there is a good chance for any conodont faunule to have been vashed out and redeposited in considerably younger strata.

If such a thing had happened, one ought to find a rather irregular listribution of the different conodont species. The fact is that at least wo distinct faunal zones were found in all localities and that each auna is restricted to its own zone. Single individuals of older species lo occur in many of the faunas, but as a rule they are worn, and they lo not normally make up a noticeable percentage of any fauna.

The failure of the Campbell method to produce good conodont speci-nens might explain why secondary deposition of conodonts is rare in he strata investigated. The conodonts were as strongly worn as the est of the rock fragments and the glauconite.

This is probably due to the abundance of pyrite in most of the strata. The hardness of that mineral is 6–6,5, whereas that of apatite is about 5 and that of glauconite negligible. One might suppose that at least some of the pyrite is authigenic and it has thus prevented more easily worn particles from being preserved at the erosion of a certain stratum. As a matter of fact, most conodonts are fairly well preserved, except that they are often broken. This might to some extent be due to the treatment at the removal from the matrix. However, many broken specimens are found embedded in the rock.

If one may thus assume that conodonts are as useful for stratigraphic purposes as other fossils (against which, by the way, the same argument would be valid) the following conclusions can be made. In the strata investigated there are, in ascending sequence,

1. a zone chiefly characterized by *Acodus tetrahedron* n. sp., *Cordylodus angulatus* Pander, *Cordylodus rotundatus* Pander and *Oneotodus variabilis* n. sp.,
2. a zone with *Drepanodus proteus* n. sp. and *Paltodus inconstans* n. sp.,
3. a zone with *Oepikodus smithensis* n. sp., *Oistodus lanceolatus* Pander, *Oistodus triangularis* n. sp. and *Prioniodus evae* n. sp., and
4. a zone with *Prioniodina densa* n. sp. and *Prioniodus navis* n. sp.

The boundaries between these zones coincide with those between

1. the zone of *Ceratopyge forficula*,
2. the zone of *Megalaspis planilimbata*, earlier form,
3. the zone of *Megalaspis planilimbata*, younger form and
4. the zone of *Megalaspis limbata*.

At Stora Backor, one can distinguish the L. and U. Planilimbata zones. The shale with *Phyllograptus densus* falls within the U. Planilimbata zone (cf. e. g. Skjeseth 1952, diagram p. 151).

At Tomten, the Planilimbata Limestone is bipartite. Both parts are thin. There seems to be no *Ceratopyge forficula* stratum.

At Bjällum, the phosphoritic glauconite limestone resting on the Cambrian belongs to the U. Planilimbata zone. This zone is 0.5 m thick and includes shale assigned to the L. Didymograptus Shale.

At Ulunda, the basal stratum might belong to the *Ceratopyge forficula* zone, but probably does not. The L. Planilimbata zone is c 0,3 m thick and strongly glauconitic. The U. Planilimbata zone is at least 3,4 m thick. The differences between the Bjällum and Ulunda sections are remarkable, considering that they are only 4 km apart.

The Skultorp section seems to contain passage beds between the L. and U. Planilimbata zones. The finding by Westergård of *Megalas-*

*ides dalecarlicus* together with *Symphysurus breviceps* in the stratum nmediately above my sample 4 points in that direction. Further, I ave found *Niobe* sp. aff. *obsoleta* in sample 4. On the other hand, mple 4 contains a few specimens of *Oepikodus smithensis* and *Oistodus nceolatus*, whereas *Prioniodus evae* begins in sample 5.

At Lanna and Latorp there are not any Ceratopyge strata, yet ey obviously were once deposited.

At Yxhult, there is no *Ceratopyge forficula* zone. The L. Planilimbata imestone is 0.8 m thick. There is a very beautiful U. Planilimbata onodont fauna in sample 7.

Long-distance correlation by means of conodonts seems largely be based on genera shared by the formations and general resemblance the forms (cf. e. g. RHODES 1953 b, pp. 269–277). Correlation by eans of genera will, it seems to me, be tentative at the best. Different uthors have given different meanings to the genera. As pointed out rther on, the way to avoid chaos and meaninglessness in conodont assification is strict adherence to the definitions of the genera, and specially to the objective characters. This will mean that similarly aped and possibly related conodonts with different objective characers will be brought to different genera, and this, in turn, will reduce e stratigraphic usefulness of the genera. Further, prolonged research bviously tends to increase the stratigraphic range of many genera striking example is the Tremadocian *Ambolodus* n. sp. recorded in is work).

In the future, it will probably be possible to correlate by means of ecies to a larger extent than at present. Many species common to urope and N. America were listed by RHODES (1953 b). Some are added this work, and there would probably had been more of them, had the wermost Ordovician strata of N. American been even more intensely arched for conodonts than is at present the case.

*Cordylodus angulatus* and *rotundatus* PANDER were found by FURNISH 938, p. 320) in the lowest part of the Oneota formation of Minnesota. he Oneota formation is regarded as lowermost Beekmantown (cf. UTTS 1939, pp. 317, 326).

*Distacodus expansus* (GRAVES & ELLISON 1941) was originally found the upper part of the lower member of the Marathon formation of exas, i. e. below the Monument Spring member. From strata below e Monument Spring dolomite KING (1937, p. 30) records i. a. *Didyograptus nitidus* (HALL), *Didymograptus patulus* (HALL), *Didymoaptus* cf. *extensus* HALL, *Phyllograptus typus* HALL and *Phyllograptus na* HALL. Above the dolomite member is *Didymograptus bifidus* IALL). This would indicate that the lower member of the Marathon formation does not extend as high as the *Didymograptus bifidus* zone. One might tentatively correlate the upper part of that member with the U. Planilimbata Limestone of South-Central Sweden. This correlation is corroborated by the occurrence of *Distacodus expansus.*

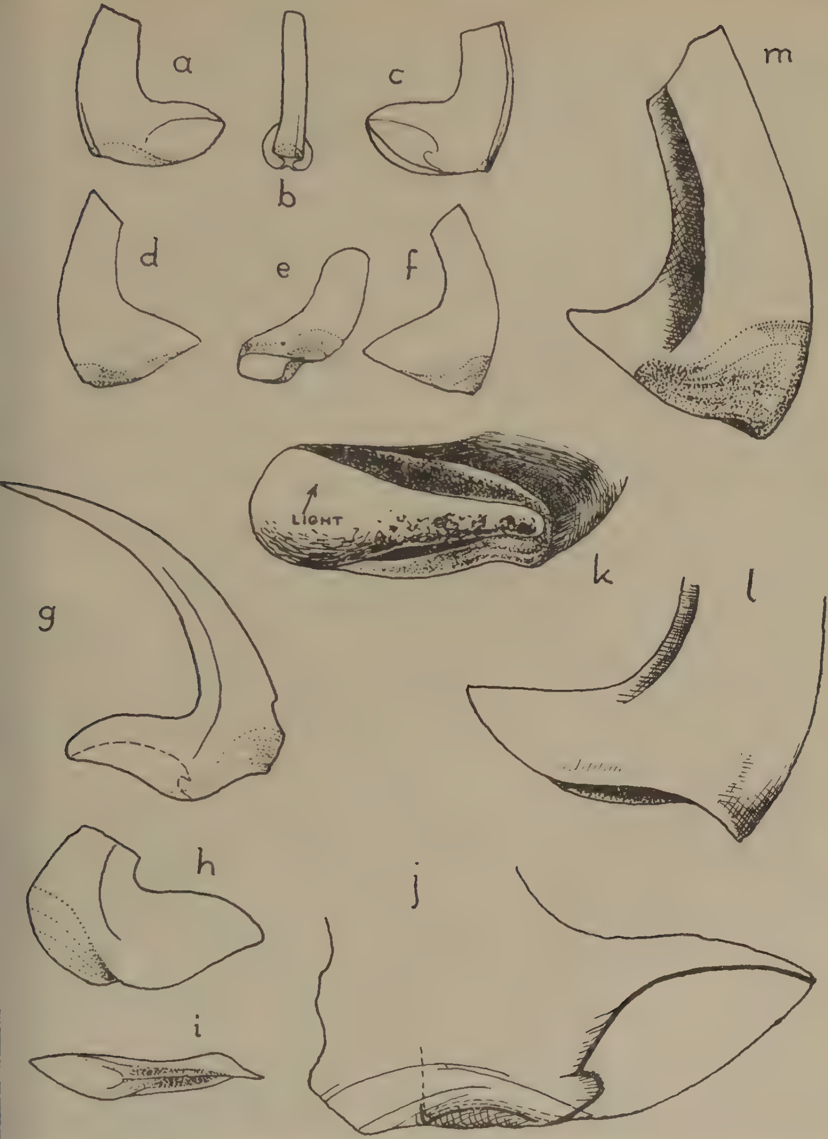
*Falodus prodentatus* (GRAVES & ELLISON 1941) originally was found in the Fort Peña formation and the Woods Hollow shale of Texas. The Fort Peña formation yielded *Didymograptus* and *Tetragraptus* yet was correlated with the Chazyan (KING 1937, p. 34), or even the Black Riveran. In Sweden it occurs in the U. Planilimbata zone. It is obvious that in this case no correlation is possible. On the contrary, it suggests itself that the species is secondarily deposited in the higher formations of the Marathon basin.

*Drepanodus homocurvatus* n. nom. and *Drepanodus suberectus* (BRANSON & MEHL) both seem to be long-range species of little value in stratigraphy.

The species from the Baltic Provinces cannot yet be used for correlation with that area. It has often been assumed that species like *Drepanodus arcuatus*, *Oistodus lanceolatus* and *Prioniodus elegans* were originally found by PANDER in the Glaukonitsand, i. e. approximatel *Ceratopyge forficula* strata. Pander himself does not state the exact derivation of any of his specimens. He discerns the following Ordovician strata (best in PANDER 1858, p. 110), 1. blue clay (basally), 2. Ungulite sandstone, 3. shale, at the base interbedded with the former, 4. greensand and 5. (at the top) limestone, in the lower parts with green grains, in the middle with clayey lamellae and at the top marly and with Crinoid fragments. He further states that the Ordovician fish remains mainly occur in the clayey, not in the sandy beds (see, however, below). Of these strata, the Blue Clay is Lower Cambrian. The Ungulite sandstone (= Obolus Sandstone) has yielded conodonts (ÖPIK 1929, p. 16), but none were found by PANDER (1856, p. 14), and so has the shale (= Dictyonema Shale) (ÖPIK 1927, p. 40). The greensand contains the most conodonts (PANDER 1856, p. 14). All these sediments are actually rather consolidated and unsuitable for the washing methods of PANDER (1858, p. 110). As mentioned, he also states that he had difficulties with the sandy beds. Clayey strata are recorded by him from the limestones above the greensand. These clay-bands would rather correspond to part of the Megalaspis Limestone with *Megalaspis limbata* (cf. ÖPIK 1927, p. 42), a rather plausible origin at least for *Oistodus lanceolatus.*

## V. Nature of conodonts

The discussion in this chapter is concerned only with the interpretation of so-called lamellar conodonts, fibrous conodonts being



g. 2. Examples of inverted basal cavity. Zone of receding growth lamellae stippled,
cept at *j*. *a—f Drepanodus proteus* n. sp. *a—c* specimen LO 3545 t, Stora Backor 8,
& *c* lateral views, *b* anterior view, shape of basal cavity shown by full line. *d—f* speci-
en LO 3546 t, same as pl. 2, fig. 19, *d* & *f* lateral views, *e* anterior and sligtly inferior
ew. *g—i Distacodus expansus* (Graves & Ellison, 1941). *g* specimen LO 3547 t, same
pl. 2, figs. 14. 15, shape of basal cavity shown by broken line. *h* & *i* specimen LO
48 t, Yxhult II 7, *h* lateral and *i* inferior view. *j Drepanodus proteus* n. sp., half dia-
ammatic drawing showing basal cavity, ends of the older growth lamellae against the
vity, and receding growth lamellae towards the antero-basal angle. Margins of a single
owth lamina indicated by broken lines. *k—m Acontiodus rectus* n. sp. *k* & *l* specimen
3549 t, Bjällum 6, *k* inferior and *l* lateral view. *m* specimen LO 3550 t, Bjällum 6,
lateral view. *a—i* × 48, *j* × 220, *k—m* × 90.

less known and of rarer occurrence. When conodonts are spoken of in this study, lamellar conodonts are meant. Up to the present date, the following is known about this group.

1. Properly understood, they are a homogenous group.
2. They are composed of calcium phosphate, physically and chemically agreeing with i. a. dahllite (Ellison 1944).
3. Structurally, they are made up of very thin continuous lamellae (e. g. Hass 1941).
4. These lamellae are concentric around the tip of a basal cavity that may be considerably reduced.
5. The successive lamellae tend to be steadily thickened at certain points and in certain directions. Along such 'growth axis', cusp. ramifications and denticles form.
6. If part of the conodont was broken away while secretion of the lamellae was still going on, later growth lamellae repaired the loss. (Furnish 1938, p. 324, Hass 1941).
7. The basal cavity may be filled by a substance that has been described as bone-like (Branson & Mehl 1933, p. 5).
8. Compound conodonts have been found in natural assemblages in shales of Pennsylvanian age. Such assemblages contain about 12 specimens representing 4—5 different 'species' belonging to different 'genera'. They bear some resemblance to the jaw apparatus of an annelid or the branchialia of a fish (Schmidt 1934, Scott 1934, Du Bois 1943, Rhodes 1952).

Beckmann (1949) found green conodonts with very fine branching canals. Green conodonts are, to my knowledge, reported nowhere else in litterature. This indicates that the state of preservation of Beckmann's conodonts may be extraordinary and, perhaps, imperfect. His highly interesting observations must await confirmation from a better material. Hass (1941) did not find any of Beckmann's very fine canals, nor have I, in a big material consisting of amber yellow and largely translucent conodonts, found anything similar.

Zittel & Rohon (1886) figure some coarse canals in their pl. 2, fig. 1 and interpret them as parasite borings. Hessland (1949, p. 415) supports this interpretation by referring to it. My material has made me believe that such supposed algal borings may instead be regarded as a morphological feature at least of certain Lower Ordovician conodonts. They occur in a vast number of specimens from all strata (admittedly not in all specimens), especially in the simple forms, and everywhere are they restricted to the basal part. Most of them form connections between the basal cavity and the exterior, others open only into the basal cavity, others, again, only towards the exterior. Some of em are confined within the conodont substance and lack an opening. hey may be very short, or long, winding and branching. There is a rong tendency towards linear orientation parallel to the growth axis. hey are uniformly thick and are never seen to give off finer branches. the descriptions of species I refer to them as basal canalules.

As suggested under point 4, the lamellae are known basally not ly to cover the exterior surface of next older lamellae but also to a naller or greater extent to protrude a bit farther. The interior surfaces these rims of the lamellae together form the wall of the basal cavity. hus, the depth of the basal cavity will depend on how far each lamella rojects beyond the margin of the next older lamella. In my material is, however, the rule in some of the species that along part of the boral margin the lamellae, instead of completely covering the next lder lamellae, leave a narrow marginal strip of the latter free. The ppearance of such a marginal zone of successively receding growth mellae will be the same as that of the interior of the basal cavity. call the feature thus described 'inverted basal cavity' (textfig. 1, text-g. 2). It commonly occurs at the antero-basal angle, especially where at angle is thin and drawn-out, and along other basal projections, s in *Oistodus longiramis*. In one specimen of *Acontiodus rectus* (fig. 2, . 1) the inverted basal cavity has invaded the realm of the basal cavity roper in an unique way in being developed as a shelf within the aboral argin.

Fillings of the basal cavity are very common in my material. They re of two kinds. One kind is blackish brown and amorphous or, in ne case, obviously lamellated. This kind of basal filling is very com-on in *Ceratopyge* strata and also occurs in a great number of younger pecimens. Whereas all conodonts are dissolved in dilute hydrochloric id, this filling is left undissolved. When strongly heated it is reduced white ashes. It completely withstands treatment by concentrated otassium hypochlorite solution, is unaffected by 5 hours boiling in oncentrated solution of caustic potash and gets a very thin carbon oating by boiling 5 hours in concentrated sulphuric acid. The other nd of basal filling (pl. 7, fig. 2), like the conodonts proper, is not ssolved by dilute acetic acid and, like them, is dissolved by hydrochlo-c acid. It has not been found in *Ceratopyge* strata, but in younger pecimens it is not uncommon. It is found in the same younger species the organic filling. In polarized light it reacts in the same way as e conodonts. It is composed of very thin, undulating lamellae that ay give rise to globular structures. In polarized light, the globules ow the characteristic oolithic cross (cf. Ørvig 1951, pp. 400, 401).

My attempts to reconstruct natural assemblages similar to those from Pennsylvanian black shales have been unsuccessful. For this purpose species must be found that fulfil the following requirements, they should have identical stratigraphic ranges, their numeric ratios should be more or less constant in all the strata where they are found and they should be morphologically related. Of these requirements the first is the most important and the last by far the least.

Groups of species like *Cordylodys angulatus* — *C. rotundatus* — *Pravognathus aengensis*, *Drepanodus arcuatus* — *D. sculponea*, *Oistodus parallelus* — *Scandodus pipa*, *Acontiodus rectus* — *Scandodus rectus*, *Oistodus delta* — *O. lanceolatus* — *O. triangularis* and *Acodus gladiatus* — *Oepikodus smithensis* — *Prioniodus evae* that fulfil some or all of these requirements can be constructed, yet they are not related to Pennsylvanian assemblages and, being highly conjectural, seem to be of little relevance to the conodont problem.

It is not with a very large material that one is left when faced with the question of the systematic position of conodonts. The chemical composition certainly is important, yet not fundamentally. One can point at such an elementary fact as that brachiopods may have mainly carbonatic or mainly phosphatic shells. CLARKE & WHEELER (1922) furnish a great number of examples of the inorganic composition of marine invertebrate shells. The tubes of *Hyalinaecia*, an annelid, contains about 25 % $Ca_3P_2O_8$, major crustaceans 6,6 %—49.6 % and very small crustaceans as much as 75 %—91 % $Ca_3P_2O_8$. On the other hand, echinoderms and mollusks only contain traces. It is not recommendable to refer conodonts to a certain phylum on the basis of composition alone.

In being composed of very numerous compact lamellae that are neither, in the best of materials, seen to be perforated by any kinds of very thin canals nor contain any regularly occurring cell-spaces and that are secreted centrifugally (as proved by point 6, beginning of this chapter) conodonts differ from hard tissues in vertebrates. The basal filling that has been referred to as bone-like in certain earlier works, at least in my material is nothing like bone. The organic filling might even be regarded as chitinous. The Liesegang structures of the inorganic filling occur in widely divergent groups (ØRVIG 1951, p. 433, footnote 1).

Because the conodont substance was secreted centrifugally and regenerated, conodonts could not have belonged to the exoskeleton of an arthropod, nor were they part of the jaw-apparatus of an annelid (as for formation of latter, see LANGE 1949, p. 12), nor of the radula of a mollusk. All other arguments against or in favour of such an interpretation of conodonts are superfluous.

In the jaw-apparatus of a chaetognath one will find an arrangement ery similar to that of a conodont assemblage. According to Krum-ach (1903) chaetognath jaws, unlike annelid jaws or radula teeth, re not cuticular. They are, however, entirely composed of chitin, ith a tough outer membrane and an inner body of spirally arranged brils. The basal cavity extends all the way to the apex, and an ex-eedingly small apical part is distinct and but loosely jointed to the est of the jaw. One might add that conodonts, with the greatest cur-ature basally instead of apically, were little suited to seize any prey. hus, one might safely exclude chaetognaths, as now developed, from he discussion of conodont nature.

Discussing the systematic position of conodonts from a purely func-ional point of view will, admittedly, not lead to any convincing results. egardless of other arguments, it would be hard to assign to a long, ail and extremely slender form like *Oepikodus smithensis* a place in he masticating apparatus of an annelid or of any other organism. In *rioniodus erae* it is hard to find any use for mastication in which one of the denticulate edges, especially the posterior and strongly wisted one, would be useless. Would not the long and slender cusp be strong hindrance to the use of *Trichonodella flabellum* in mastication? Iow could the simple teeth that are almost straight apically be used seizing or chewing a prey without an un-economic pushing apart of heir bases? Why the profuse development of costae, keels and den-iculate edges, when all that is needed in chewing is provided by the imple and persistent pattern of annelidan jaws? One might hazard a uess that at least most conodonts did not have any function in actively eizing and chewing food. The supposition of Hass (1941, p. 81) that hey acted as internal supports of tissues of some kind seems much nore likely to me. The tendency towards increase of surface, greater pread of denticulate edges, etc. suggests that this hypothetical tissue as occupied either in food-gathering, or in respiration or secretion. t any rate, these are loose speculations.

It seems as if, at present, no satisfactory solution of the conodont roblem were available.

## VI. Classification of conodonts

Since one can be certain that several kinds of conodonts existed in he same organism, the object of the classification of isolated cono-onts could not be to expound phylogenetic relationships between the ifferent kinds of conodonts. Classification of isolated conodonts rather as to restrict its aims so as to provide the worker concerned with onodonts, especially in the field of stratigraphic geology, with clear-ut morphological cathegories.

For this purpose the highest possible degree of objectivity is desirable. To attain an objective classification of conodonts one must pay attention to such absolute characters as costae and denticles and, to some extent, symmetry. Most other characters are relative, such as width of the base, curvature of the cusp, whether the indentitions of the aboral margin are so deep as to define basal processes or not, etc. Similar conodonts with differences in the costation or the distribution of denticles may thus be brought to different genera. I do not think that this disadvantage outweighs the advantages of a more objective classification.

In no genus should conodonts be placed that do not possess the characteristics stated for that genus. A denticulate conodont should not be brought to an undenticulate genus, and a markedly unsymmetrical conodont should not be regarded as belonging to a genus for species that are, in the main, symmetrical. This might seem self-evident but has been widely neglected by protagonists of a would-be natural classification. Exceptions are, when a conodont that does not possess one or other of the generic characters obviously belongs to a species most specimens of which do conform with the genus, or when a group of similarly aberrant conodonts can preferably be regarded as a modification (whether of subspecific rank or not) of such a species.

The status of conodonts in zoological nomenclature has been subject to some discussion. According to Art. 27 of the International Rules the principle of priority will be at work if any part of an animal is described before the animal itself. Conodonts are fossil parts of animals, and obviously several kinds (species, genera) of conodonts were parts of the same animal. Yet it is thus strictly 'legal' to erect a species for a number of highly similar conodonts. Up to a certain point. *Ligonodina typa* (GUNNELL), *Lonchodina clarki* (GUNNELL), *Hibbardella subacoda* (GUNNELL), *Metalonchodina bidentata* (GUNNELL) and *Prioniodus conjunctus* (GUNNELL) are all valid names. The point at which they all become synonyms is when RHODES (1952, pp. 895—898) finds them together in undoubtedly natural assemblages and describes them as belonging to a single animal species. According to SINCLAIR (1953, p. 489), he should now select any of these names to be the valid name of the species as a whole. This is perfectly in the spirit of the Rules. Going one step further, that name will also apply to the other component conodonts. This is where most micro-paleontologists will protest. For conodonts in present research are not only, nor even chiefly, zoological documents. Above all, they are stratigraphic tools. As such, they are entitled to the most possibly unchangeable names of their own. The number of conodont species in any assemblage as a rule is five. This neans that with the finding of greater numbers of assemblages, an ven greater number of useful index fossils will have their names hanged. To put it drastically, it will be in the interest of micro-paleonologists to find as few conodont assemblages as possible! These remarks nay be regarded as coplementary to the more detailed objections against he line of reasoning consequent to the rules that are raised by Rhodes 1953 a).

It would be of considerable help to micro-paleontology if it could e provided that any name valid under Art. 25 and proposed for a roup of morphologically similar fossils regardless of whether they nce coexisted with other known fossil remains in the same animal hould have priority over any later published name for the same group.

It seems a bit out of place that such organ-groups should be called pecies and be referred to genera, even if it is silently understood that orm species and form genera are meant. The *Ordo militaris* of Croneis 1938, 1941, p. 1245) seems as well suited in this case to replace the Linnaean terms as any other system, and I cannot understand why it hould not be adopted.

These matters might, however, be better treated by a geological orum than by the International Commission on Zoological Nomenlature, or, rather, by both in turn. It is obvious that even with the upport of geologists units published under the *Ordo militaris* would e likely to be ignored by zoologists and a number of confusing homoyms thus arise.

## VII. Systematics

Key to the genera found (except *Ambolodus*, *Nericodus* nd *Pravognathus*).

|  |  |  |
|---|---|---|
| 1. | Simple (undenticulated) teeth | 2 |
|  | Compound teeth | 10 |
| 2. | The posterior margin passes into the oral margin by a curve, however sharp | 3 |
|  | The posterior margin makes a sharp angle with the oral margin | *Oistodus* |
| 3. | Symmetrical forms | 4 |
|  | Unsymmetrical forms | 8 |
| 4. | Cross section rounded, normally without keels or costae | *Oneotodus* |
|  | With keels or costae | 5 |
| 5. | Anterior and (or) posterior keel, no costae | *Drepanodus* |
|  | Costae exist | 6 |
| 6. | Several costae | *Scolopodus* |
|  | Two costae | 7 |

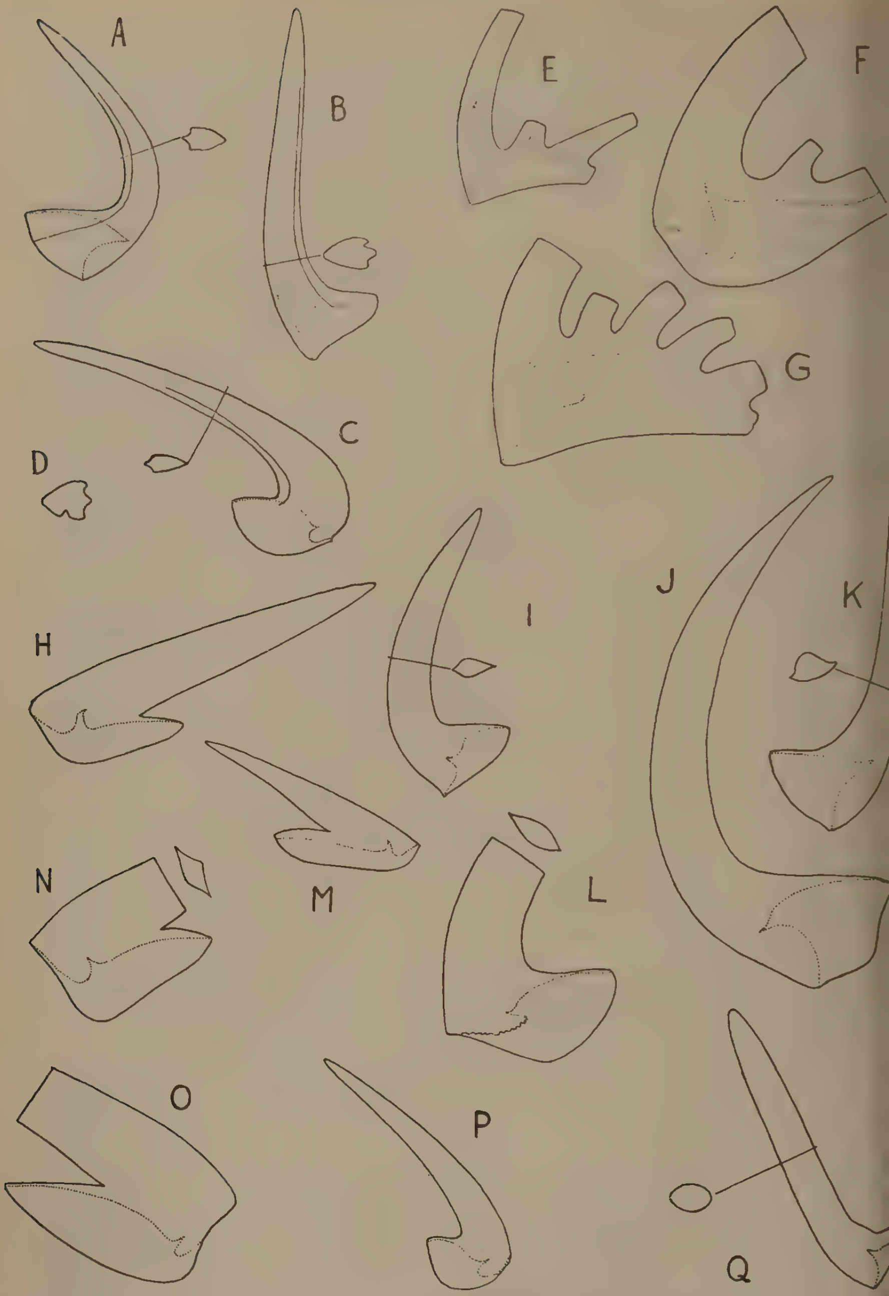


Fig. 3. Cross sections and basal cavities. Basal cavities shown by stippled lines. Half diag
matic. Average magnification × 50. A *Acontiodus arcuatus* n. sp., B *A. rectus* n. sp., C *A*
*clinatus* n. sp., D *A. rectus sulcatus* n. var., E *Cordylodus angulatus* PANDER, specimen LO
t, F *C. rotundatus* PANDER, G *C. angulatus* PANDER, H *Oistodus contractus* n. sp., I *Drepon*
*numarcuatus* n. sp., J *D. arcuatus* PANDER, K *Scandodus rectus* n. sp., L *Drepanodus sculpon*
sp., M *Oistodus forceps* n. sp., N *O. parallelus* PANDER of the *Ceratopyge forficula* zone, O *C*
*rallelus* PANDER of the Planilimbata Limestone, P *Scandodus pipa* n. sp.,
Q *Scolopodus? peselephantis* n. sp.

7. Costae posteriorly .......... *Acontiodus*
   Costae medially or anteriorly .......... *Distacodus*
8. No lateral costae .......... *Scandodus*
   Costae exist .......... 9
9. One lateral costa .......... *Acodus*
   Several lateral costae .......... *Paltodus*
10. With posterior denticulated process only .......... *Cordylodus*
    With two or several processes .......... 11
11. Two processes .......... 12
    Several processes .......... 14
12. Both processes denticulated .......... *Prioniodina*
    Either process undenticulated .......... 13
13. Anterior process undenticulated .......... *Paracordylodus*
    Posterior process undenticulated .......... *Falodus*
14. Three processes .......... 15
    Four processes .......... 17
15. Posterior and two anterior processes, posterior may be undenticulated .......... *Trichonodella*
    Posterior, lateral and anterior process .......... 16
16. Only posterior process denticulated .......... *Gothodus*
    All three processes denticulated .......... *Prioniodus*
17. Two anterior and two posterior processes .......... *Trapezognathus*
    Anterior, posterior and two lateral processes .......... 18
18. Only posterior process denticulated .......... *Oepikodus*
    All four processes denticulated, except sometimes the anterior .......... *Tetraprionioodus*

In the following descriptions the genera and species are arranged alphabetically. Synonymy lists are only provided where they add to the knowledge of the systematic units or are necessary to illustrate the arguments. For further synonymies, see FAY 1952.

The following abbreviations are used,

Ce. zone = zone of *Ceratopyge forficula*,
L. Pl. Ls. = Lower Planilimbata Limestone,
U. Pl. Ls. = Upper Planilimbata Limestone,
Lb. Ls. = Limbata Limestone.

### *Acodus* PANDER, 1856.

Type species. *Acodus erectus* PANDER, 1856.

Pander's description (translated from PANDER 1856, p. 21). Teeth more or less curved, with front and hind keels as a rule unequally big. The lateral faces are unsymmetrical, one evenly convex, the other more strongly developed, standing out as a blunt or sharp carina. The different curvature of the teeth and the difference of size in the carinae of one of the lateral faces makes us separate the following single forms from one another'.

Remarks. Species with a rounded lateral carina might perhaps be brought to *Drepanodus*, if they are symmetrical for the rest. Some of the species here treated under *Acodus* might belong to *Sagittodontus* RHODES, 1953 (p. 310). However, I am almost sure that that genus might better be regarded as a synonym of *Acodus*.

*Acodus* is also mentioned in my discussion of *Paltodus* PANDER, 1856.

### *Acodus deltatus* n. sp.

Pl. 3, fig. 30.

Derivatio nominis. The name refers to the outlined of the three basal facets, and of the basal cross-section.

Holotype. LO 3620 T, Pl. 3, fig. 30.

Diagnosis. An *Acodus* with big base, three rather widely divergent edges and a broad, blade-like, proclined cusp.

Description. The basal sheath is very thin. Its edges are straight. The anterior and oral edges diverge at almost 90°. The lateral edge diverges from the two others at somewhat smaller angles. All three edges are sharp. They continue up the broad base of the short and blade-like, rapidly tapering cusp. The cusp is slightly proclined.

Occurrence. The holotype is from the L. Pl. Ls. of Yxhult, section II, sample 3. The species is rather rare in the L. Pl. Ls.

Material. 20 specimens.

### *Acodus deltatus* n. sp. var. *altior* nov.

Pl. 3, figs. 27—29.

Derivatio nominis. *Altior*, Lat. = higher.

Holotype. LO 3619 T, pl. 3, fig. 29.

Diagnosis. Like *A. deltatus*, but more elongate, with less divergent edges.

Description. The basal sheath is thin. The base as a whole is laterally compressed. The anterior and oral edges diverge at about 30°. The cusp is rather long and slender, and rather strongly proclined.

Occurrence. The holotype is from the L. Pl. Ls. of Tomten, sample 3. The variety is very rare in the L. Pl. Ls.

Material. 5 specimens.

### *Acodus gladiatus* n. sp.

Pl. 3, figs. 10—12.

Derivatio nominis. *Gladius*, Lat. = sword, refers to the sharp, blade-like, uncostate cusp.

Holotype. LO 3605 T, pl. 3, figs. 10, 11.

Diagnosis. An *Acodus* with rather small base and big, blade-ke, uncostate cusp.

Description. The basal cavity flares basally and is rather high nd narrow apically. Its point appears blunt in slight magnification, ut actually it is strongly constricted before giving off the ultimate, xceedingly slender tip. The base is triangular in cross section, there eing an anterior, a lateral and an oral edge, all three of which are ounded. The three edges diverge rather widely. The lateral edge is ather near the anterior edge. The aboral margin is more or less indened between the three corners.

The cusp is high, erect or recurved, and blade-like with sharp anerior and posterior edges. It is widest about middle height that is t the level of the point of the basal cavity. It carries no costa corresonding to the lateral flange of the base.

There are thin basal canalules.

Occurrence. The holotype is from the base of the U. Pl. Ls. f Yxhult, section II, sample 7. The species is uncommon in the U. l. Ls.

Material. 26 specimens.

### *Acodus gratus* n. sp.

Pl. 2, figs. 27—29.

Derivatio nominis. *Gratus*, Lat. = pleasing.

Holotype. LO 3580 T, pl. 2, fig. 27.

Diagnosis. A long, slender, recurved *Acodus* with an anterior teral costa that basally widens into a narrow flange.

Description. The basal cavity is roughly conical, like that of *repanodus homocurvatus*. The oral edge is short, keeled, and almost raight. The aboral margin is convex in side view. Its rim may show n undulation. The antero-basal angle is rather sharp.

The cusp is long, slender, and rather strongly recurved. Its edges e sharp. The anterior edge may be flexed sideways.

To the side of the anterior edge there runs a thin lateral costa that ay basally take the place of the edge, as in pl. 2, figs. 28, 29, or curve ckwards, as in the holotype.

Remark. There have been found a few specimens intermediate tween this species and *Drepanodus homocurvatus*.

Occurrence. The holotype is from the base of the U. Pl. Ls. of xhult, section II, sample 7. The species is uncommon in the U. Pl. . and above.

Material. 41 specimens.

### *Acodus pulcher* n. sp.

Pl. 2, fig. 38.

Derivatio nominis. *Pulcher*, Lat. = beautiful.

Holotype. LO 3589 T, pl. 2, fig. 38.

Diagnosis. A recurved *Acodus* with the base flaring to one side and a thin anterior lateral costa to the other.

Description. The basal cavity is rounded in lateral view, and not very deep. The oral margin is rather short, and keeled anteriorly. The aboral outline is ovoid in basal view, widest posteriorly and flaring to one side. In lateral view, the aboral margin is almost straight, making an angle of about 70° with the oral margin. With the anterior edge it makes a similar angle.

The cusp is recurved. Its lateral faces are rounded, the edges sharp. A thin anterior lateral costa runs close to the anterior edge.

Occurrence. The species was found in the Ce. zone of Stora Backor, sample 5.

Material. 8 specimens.

### *Acodus tetrahedron* n. sp.

Pl. 4, figs. 1, 2.

Derivatio nominis. The name refers to the unusually regular tetrahedral shape of the base.

Holotype. LO 3642 T, pl. 4, figs. 1, 2.

Diagnosis. An *Acodus* with rather small tetrahedral base and rather big, blade-like, proclined cusp.

Description. The basal cavity is thin-sheathed, tetrahedral, with the triangle facing anteriorly slightly narrower than the others laterally. The oral edge is sharp, rather short, and somewhat concave. The aboral margin is almost straight in side view, making an angle of 60°—90° with the oral edge.

The cusp is proclined, almost straight-edged, and rather long and wide. It is compressed laterally. The edges are sharp. The lateral costa arises quite close to the anterior edge, not far above the base.

Occurrence. The holotype is from the Ce. zone of Stora Backor, sample 5. The species is rare in the Ce. zone. One specimen was found in the L. Pl. Ls. of Lanna, sample 1.

Material. 13 specimens.

### *Acontiodus* Pander, 1856.

Type species: *Acontiodus latus* Pander, 1856.

Pander's description (translated from Pander 1856, p. 28). 'Among the simple teeth there remain three forms that seem to be of very rare occurrence. Albeit they do not resemble each other in all spects and must later be separated have we brought them under one ıme. — The main character consists in the relatively strong devepment of the concave margin of the tooth. Rather than being sharp ıd wedge-like does this margin form a flat or slightly concave face ıat is either even, as in *Acontiodus triangularis*, or provided with a ıarp and prominent median keel, as in the other two species. The vo lateral surfaces on uniting at the convex margin either form a ırve, passing one into the other without the intervention of a keel, ; in *Acontiodus latus*, or meet at almost right angles, as in the other vo species'.

Remarks. I have found three species all of which agree with the ʼpe species and *A. gracilis* PANDER in that they are quite or almost ʼmmetrical and have smooth lateral faces (see, however, *A. rectus ılcatus*), one posterior keel and two posterior lateral costae. In these spects they also agree with *A. iowensis*, *propinquus* and *staufferi* ıat are described by FURNISH 1938. *Acontiodus abnormalis* BRANϽN & MEHL, 1933 without posterior lateral costae and with additional riae anteriorly and *A. alveolaris* STAUFFER 1935 b without the posterior eel might, I think, both be removed from the genus. One might argue ıat the faint striae in *A. abnormalis* BRANSON & MEHL should not e sufficient to put it aside. This would have been true if they occurred poradically. As it is, they are said to characterize the species (BRANSON MEHL 1933, p. 57). *A. dubius* GRAVES & ELLISON, 1941 (p. 9, pl. 2, g. 1) seems to be best referable to *Scolopodus*. After excluding the ıid species one may define the genus as follows.

Redefinition. To the genus *Acontiodus* belong simple, more less symmetrical conodonts with smooth lateral faces and a posterior eel to each side of which is a lateral costa.

*Acontiodus arcuatus* n. sp.
Pl. 2, figs. 1—4, textfig. 3 A.

Derivatio nominis. The tooth is arcuate.

Holotype. LO 3559 T, pl. 2, fig. 4.

Diagnosis. A slender, laterally compressed, evenly recurved ontiodus with sharp oral and anterior edges and deep basal cavity.

Description. The basal cavity is strongly compressed laterally ıd about as deep as it is wide at the aboral margin. It is roughly iangular in outline and curved in an aboral direction in such a fashion at a sickle-shaped space is formed between its anterior margin and at of the tooth. This sickle-shaped solid part of the base is very in and generally a bit deflected laterally.

The cusp is so recurved as to reach posteriorly as far as does the base.

All along the cusp and to the aboral margin of the base there run two keels, one posterior and one anterior, and, on each side of the posterior keel, a costa.

On the base, and especially in the bigger specimens, there may develop several smaller costae between the main costae and the oral edge.

An interesting feature is the presence of small canals (basal canalules) and vesicles in the basal sheath. The canals are of different sizes, very irregular, and sometimes branching. The vesicles are of very irregular appearance. The canals may be connected with the basal cavity or the exterior, but some are entirely confined in the basal sheath. Some run parallel to the lamination, others form straight connections between the basal cavity and the exterior. There is a tendency towards linear arrangement.

The aforesaid sickle-formed, flat and deflected anterior part of the base may be seen to be set off from the rest of the tooth by a faint ridge or elevation that runs from the posterior lateral costa to the anterior margin of the tooth at about the level of the tip of the basal cavity.

Included in the species are also those less common variants where the base is slightly shortened (pl. 2, fig. 3) or the anterior margin is not so sharply keeled at the base.

Occurrence. The holotype was found in the lower part of the U. Pl. Ls. of Yxhult, section II, sample 7. The species is rather uncommon in the U. Pl. Ls.

Material. 58 specimens.

### *Acontiodus reclinatus* n. sp.

Pl. 2, figs. 5, 6, textfig. 3 C.

Derivatio nominis. The cusp may be strongly reclined.

Holotype. LO 3561 T, pl. 2, fig. 6.

Diagnosis. A slender, almost straight *Acontiodus*, strongly recurved at the base, anterior and posterior edges sharp, lateral costae faint.

Description. The basal cavity is laterally compressed, rounded in outline, and with a shallow anterior extension. The oral margin is not keeled but forms a rounded vault over the basal cavity. The aboral margin is smoothly curved and not sharply offset from the curvature of the anterior margin. Thus, there is no antero-basal angle.

The cusp is strongly recurved just above the base, then almost straight, so that the whole tooth appears reclined rather than recurved. Its lateral faces are more or less rounded. The anterior and posterior ges are sharp. The posterior lateral costae are little accentuated, metimes even absent.

Basal canalules are found in some specimens.

Occurrence. The holotype was found in the lower part of the Pl. Ls. of Yxhult, section II, sample 7. The species is very rare in e U. Pl. Ls.

Material. 15 specimens.

### *Acontiodus rectus* n. sp.

Pl. 2, figs. 7—11, textfig. 2, k—m, textfig. 3 B.

Derivatio nominis. The species is straight.

Holotype. LO 3562 T, pl. 2, figs. 7, 8.

Diagnosis. An erect *Acontiodus* with strong posterior lateral stae, rounded basal outline and rather shallow basal cavity.

Description. The basal cavity is more or less shallow, its int far anteriorly. The oral margin forms a rounded vault over it. e basal part of the anterior margin as a rule is well rounded. The se as a whole may be wide and sharply set off from the cusp, or it ay be almost of the same thickness as the latter and hard to disnguish.

The cusp forms a more or less sharp bend just above the base, the per part of it almost straight and erect. There are common exceptns to this rule. Thus, it may be rather strongly recurved, slightly clined or proclined. in which case it is but little curved above the se which is then narrow, as mentioned above.

The anterior edge is not very sharp. The posterior edge has on each le a more or less sharply defined posterior lateral costa that almost aches the aboral margin of the base.

Basal canalules are often beautifully developed.

Along the aboral margin of the base there is often a zone of high stre. It may be very high anteriorly but always wedges out posteriorly. is lined with growth striae in the same way as the interior of the sal cavity, hence the term 'inverted basal cavity'. In some specimens is zone is so narrow as almost to be restricted to the very rim of the sal cavity. This may be visible on pl. 2, fig. 9. In one specimen (text. 2, k, l) the zone has crossed the margin and is developed as a little oved shelf inside the basal cavity.

Occurrence. The holotype is from the U. Pl. Ls. of Lanna, mple 12. The species is abundant from the base of the U. Pl. Ls. wards.

Material. 600 specimens.

### *Acontiodus rectus* n. sp. var. *sulcatus* nov.

Pl. 2, figs. 12, 13, textfig. 3 D.

Derivatio nominis. There is a furrow, *sulcus*, along one side.

Holotype. LO 3566 T, pl. 2, figs. 12, 13.

Diagnosis. Like *Acontiodus rectus*, but with a conspicuous furrow along one lateral face.

Remarks. There is nothing to be added to the diagnosis. This is, in fact, a *Paltodus*. However, it seems impossible to separate it further from *Acontiodus rectus*. In some specimens of *A. rectus* there is a beginning of such a furrow, e. g. in the specimen figured in textfig. 2 l, where this feature is slightly shaded.

Occurrence. The holotype is from the base of the U. Pl. Ls. of Yxhult, section II, sample 7. The variety is rare in the U. Pl. Ls.

Material. 10 specimens.

## *Ambolodus* Branson & Mehl, 1933.

### *Ambolodus* n. sp.

Pl. 6, figs. 45, 46.

Description. The basal cavity is rather deep and wide, extending all along the specimen. Its wall is thin. The main body of the conodont is very elongate and smoothly S-shaped seen from above. 1/3 the length from one of its ends it gives off a short process.

All along the summit of the main body, as well as along that of the process, there runs a row of low, thick, blunt denticles that are more or less fused. The denticle rows culminate in a rather big, blunt apical denticle where the lateral process is given off.

Remarks. Only one specimen was found. Although this specimen is excellent, I do not propose any name for the clearly new species it belongs to, since the specimen appears to be very fragile and thus unsuitable as a holotype.

Occurrence. The specimen was found in the Ce. zone of Stora Backor, sample 5.

## *Cordylodus* Pander, 1856.

Type species. *Cordylodus angulatus* Pander, 1856.

Pander's description (translated from Pander 1856, p. 33). 'Compound teeth with very long, compressed and high base. A big, rather flat, smooth cusp with smoothly curved lateral faces and almost flat anterior and posterior margins arises from the base, at first more or less vertically, always, however, curved toward the point. Several small teeth emerge from the basis at the concave margin of the big tooth, beneath one another and side by side. — To judge from the perficial appearance, one might mistake this genus for *Belodus*. The icroscopical structure is, however, entirely different.'

Remarks. Thus defined, *Cordylodus* will include the genus *Cyrto*- *odus* STAUFFER, 1935 a. The slight difference between that genus and *rdylodus* as compared with the variation within some species of *rdylodus* (see below, e. g. *Cordylodus rotundatus*) reduced its useful- ss. Also, as pointed out by ELLISON (1946, pp. 108, 110) *Barbarodina* AUFFER, 1935 b and *Subcordylodus* STAUFFER, 1935 a are synonyms *Cordylodus*.

Species with lateral ridges, like *C. multidentatus* GRAVES & ELLI- N, 1941 (p. 10, pl. 1, fig. 21) and *C. quadratus* GRAVES & ELLISON, 41 (p. 10, pl. 1, figs. 22, 25) do not belong to *Cordylodus*, nor do denticulate species like *C. simplex* BRANSON & MEHL, 1933 (p. 64, . 4, fig. 11).

### *Cordylodus angulatus* PANDER, 1856.

Pl. 5, fig. 9, textfig. 3 G, E.

56. *Cordylodus angulatus* PANDER, p. 33, pl. 2, figs. 27—31, 34, pl. 3, fig. 10.

38. *Cordylodus intermedius* FURNISH, p. 338, pl. 42, fig. 31, p. 337, textfig. 2 C.

Pander's description. 'With horizontal lower margin of e base, whereby the pulp cavity is almost triangular'.

Some details can be added to this Spartan description.

The basal cavity may be like a Phrygian cap in outline, its anterior rgin first receding strongly, then being bent forward to meet the l margin of the cavity at the apex (textfig. 3 G. Cf. also PANDER 56, pl. 3, fig. 10 a). In one specimen the lower, receding part of the rgin of the basal cavity is seen to be very uneven, interfingering, as were, with the growth lamellae. A similar structure was observed by ss (1941. p. 75. pl. 16, fig. 1) at the tip of the basal cavity of a *Bryan- us* (see also textfig. 2 j and textfig. 3 L in this work).

Another kind of basal cavity is seen in textfig. 3 E. Here the basal ity is not bent forward, but is erect from the beginning. It may o extend into the first denticle. The two kinds of basal cavities pos- ly distinguish two species. However, the basal cavity is not visible all specimens, and in external appearance the two would-be species very much alike.

The aboral margin of the conodont anteriorly is nearly straight ning upward and backward, then curves until it becomes horizontal. e oral margin is also curved, but not so strongly, and it is conver- t with the aboral margin posteriorly.

At the base the long and slender cusp leans forward, higher up it is recurved. The denticles are discrete and more or less widely spaced. There may be at least six of them. all of which are recurved.

The margins of the unit may be well rounded, or there may be blunt edges.

Remarks. FURNISH states about his *Cordylodus intermedius* that it is almost identical with *C. angulatus* although it appears to be somewhat more primitive. Since Furnish's species falls well within the range of variation in *C. angulatus* there is no need to distinguish it as a separate species.

Occurrence. *Cordylodus angulatus* is very common in the middle part of the Ce. zone of Stora Backor. Recognizable specimens are found in the L. Pl. Ls. of other localities. I have not been able to find any record of its stratigraphic appearance in Esthonia. It was found by FURNISH in the Oneota formation of Minnesota.

Material. 81 specimens.

### *Cordylodus perlongus* n. sp.
Pl. 6, figs. 36, 37.

Derivatio nominis. *Per-longus*, Lat. = very long.

Holotype. LO 3733 T, pl. 6, fig. 37.

Diagnosis. A small, thin *Cordylodus* with long, slightly arched process and numerous small, reclined denticles.

Description. The basal cavity is narrow laterally. Its anterior and oral margins are arched. The point is directed anteriorly. The aboral margin of the base is conspicuously arched, the oral margin slightly less so.

The cusp is comparatively broad, blade-like. The denticles are reclined and closely spaced. They are small and of unequal sizes. Their edges and points are sharp.

Occurrence. The species was found at the base of the Lb. Ls. of Stora Backor. The holotype is from sample 19.

Material. 10 specimens.

### *Cordylodus prion* n. sp.
Pl. 5, figs. 14—16.

Derivatio nominis. *Prion*, Greek = saw.

Holotype. LO 3684 T, pl. 5, fig. 16.

Diagnosis. A flattened, sharp-edged *Cordylodus* with erect, laterally curved cusp and reclined denticles.

Description. The basal cavity is sharply conical and reaches rather high into the cusp. Its posterior extension along the process is shallow. The aboral margin is but slightly arched and runs at a small ngle to the oral margin. The latter is straight or nearly so. Anteriorly, he base may be widened at the inner side.

The cusp is nearly erect, rather big, flattened laterally and with harp anterior and posterior edges. It is slightly bent inwards. The lenticles number at least five. They are reclined, rather small, flattened nd sharp-edged. Basally, they are fused.

Remarks. The species resembles *Cordylodus spurius* BRANSON & MEHL, 1933 (p. 117, pl. 10, fig. 4) from the Plattin formation of Missouri. t is quite distinct from that species in being flattened and sharp-edged.

Occurrence. The holotype is from the Ce. zone of Stora Backor, ample 5. The species is rare in the Ce. zone of Stora Backor.

Material. 14 specimens.

### *Cordylodus rotundatus* PANDER, 1856.
Pl. 5, figs. 17—20, textfig. 3 F.

856. *Cordylodus rotundatus* PANDER, p. 33, pl. 2, figs. 32, 33.
903. Conodont. *Cordylodus angulatus* PANDER? — WIMAN, p. 66, pl. 3, figs. 42, 43.
906. Conodont. MOBERG & SEGERBERG, p. 62, pl. 1, figs. 17, 18.
909. Conodont. WESTERGÅRD, p. 77, pl. 5, figs. 28, 29.
938. *Cordylodus subangulatus* FURNISH, p. 338, pl. 42, fig. 32, textfig. 2 D, p. 337.

Pander's description, 'With rounded lower margin of the ase of the pulp cavity so that the latter is oval in form'.

This is a highly variable species.

The basal cavity is deep, as in *C. angulatus*, and as may be the case n that species it is bent forward apically, only much more sharply, s may be seen in Furnish's textfig. 2 D and my textfig. 3 F.

The aboral margin anteriorly continues the curvature of the cusp, here being no sharp antero-basal angle. Thus, the aboral margin at irst runs more or less steeply downwards, then, approximately beneath he first denticle, it curves more strongly to run upward. At this point he base is usually broken which accounts for the figure given by PANDER. In entire specimens the aboral margin is now seen to be arched, nd in its posterior portion to run horizontally. The oral margin is nore or less smoothly arched.

The base as a whole is inflated or rather narrow. Its two sides may e of different height and curvature.

The cusp is long and slender and recurved. It is often bent out of lane with the denticles. Its posterior margin as a rule is slightly lattened. The anterior margin is well rounded. Both margins may, however, be faintly keeled. The denticles are reclined, closely spaced but discrete, and circular, elliptical or lanceolate in cross section.

In some specimens the rather thick aboral margin of the basal cavity retains a very much thinner edging that, in some specimens, may show local thickenings.

No basal canalules have been found in this species or *C. angulatus.*

Occurrence. *Cordylodus rotundatus* is common in the middle part of the Ce. zone of Stora Backor. Broken fragments are occasionally found in higher strata. WIMAN (1903, p. 66) found it in the Ceratopyge Shale of Biludden, near Gävle, and in the alum shale immediately above the Dictyonema Shale proper of Öland. MOBERG & SEGERBERG repeat Wiman's observations and WESTERGÅRD confirms them. WAERN (1952, pp. 234, 236) claims to have found similar conodonts in the part of the Bödahamn core (from N. Öland) equivalent to the Ce. zone. ÖPIK (1927, p. 39) found the species in the Dictyonema Shale ($A_3$) of Rågö, Esthonia. Furnish's *Cordylodus subangulatus* that can in no respect be distinguished from Pander's species was found in the Oneota formation of Minnesota.

Material. 48 specimens.

### *Distacodus* HINDE, 1879.

Type species. *Machairodus incurvus* PANDER, 1856.

Pander's description (of *Machairodus* PANDER, *non* KAUP, translated from PANDER 1856, p. 22). 'Here those teeth with different curvatures are brought together under one name the two convex lateral faces of which are marked by more or less sharply pointed carinae. In the ones that are the closest to *Drepanodus* the cross section forms a rhomb with four smooth facets. In the others the carinae project sharply from the lateral surfaces. Although the two lateral faces are unsymmetrical in several forms, the carina of one of them often being very sharp and thin, the one of the other face blunt and wide do we believe that this is an insufficient reason to separate the species from one another.'

Remarks. HINDE, on proposing a new name for the genus, did not add to Pander's description (HINDE 1879, p. 357).

The two lateral costae (in the terminology here used) being the chief character of the genus, no other conodonts than those simple forms provided with a lateral costa on each side should be included in the genus, nor should conodonts thus adorned be brought to any other genus, except if the costae are adjacent to the posterior margin. In that case the conodont is an *Acontiodus.*

### *Distacodus expansus* (Graves & Ellison, 1941).
### Pl. 3, figs. 13—17, textfig. 2 g—i.

941. *Acodus expansus* Graves & Ellison, p. 8, pl. 1, fig. 6.

This is a very good *Distacodus*.

The basal cavity is situated posteriorly in the base. It is more or ss compressed laterally, but it may flare rather widely, as in pl. 3, g. 17. It is rounded in outline, with its sharp point curved downward the neighbourhood of the aboral margin. Orally, the base is sharply eeled. The oral edge is rather long and smoothly curved. The aboral argin posteriorly diverges from the oral edge at about 30°. Usually, is part of the aboral margin is slightly concave. It then bends so as, nteriorly, to become subparallel to the oral edge. This stretch may, gain, be slightly concave. The antero-basal angle is otuse. At the ngle, the base is thin and translucent. It may be deflexed laterally. t always is characterized by receding growth lamellae that, on curving ward to the basal cavity, may form such a ledge as seen on textfig. 2 & i.

The cusp is rather strongly recurved or reclined. It tapers slowly a sharp point. It is sharply keeled anteriorly and posteriorly. On ach lateral face there is a posteriorly directed costa that does not each the aboral margin.

As appears from this description, the species may be hard to disnguish from *Drepanodus proteus* n. sp., except for the costae and the ırved oral edge.

Occurrence. The species is common in the U. Pl. Ls. and rare the strata next below and above that level. Graves & Ellison ound it in the middle part of the Marathon formation of Texas.

Material. 259 specimens.

### *Distacodus peracutus* n. sp.
### Pl. 3, figs. 1, 2, textfig. 5 d.

Derivatio nominis. *Per-acutus*, Lat. = highly sharp.

Holotype. LO 3601 T, pl. 3, figs. 1, 2.

Diagnosis. A straight, proclined *Distacodus* with sharp anterior ıd posterior edges and anteriorly directed lateral costae.

Description. The basal cavity is shallowly pyramidal with its oint anteriorly. The oral edge of the base is very short. The aboral argin is strongly indented where it is reached by the oral keel or the teral costae. It is highly convex between the indentations.

The cusp is straight and rather strongly proclined. It is sharply eeled posteriorly. The anterior keel is less prominent. The lateral ostae are rather high and sharp. Being close to the anterior margin and antero-laterally directed they almost obscure the anterior keel in side view.

There are two variants of this species, one of which, represented by the holotype, is found in the Ce. strata. The other is exemplified by textfig. 5 d. It is found in the L. Pl. Ls. In it, the lateral costae are much less prominent, and the cusp is not so strongly proclined. These two variants might perhaps with some advantage have been described under separate names, yet a better material seems necessary for that purpose.

Remarks. The species resembles *Ulrichodina wisconsinensis* FURNISH, 1938 (p. 336, pl. 41, figs. 19, 20) except for the depression at the anterior basal corner in that species. *Ulrichodina* FURNISH might be regarded as a junior synonym of *Distacodus* PANDER.

Occurrence. The holotype is from the Ce. zone of Stora Backor, sample 5. The species is very rare in the strata below the U. Pl. Ls.

Material. 15 specimens.

### *Distacodus rhombicus* n. sp.

Pl. 3, figs. 35, 36.

Derivatio nominis. The base is diamond-shaped in cross section.

Holotype. LO 3624 T, pl. 3, figs. 35, 36.

Diagnosis. A *Distacodus* with long base and small cusp. Costae not very strong.

Description. The basal sheath is very thin. The weak costae and keels take their origin on the cusp. The facets of the base between the costae are little or not at all depressed.

The cusp is rather small and proclined. In the holotype it has been broken and is rejuvenated.

Occurrence. The holotype is from the L. Pl. Ls. of Tomten, sample 3. The species is very rare in the L. Pl. Ls.

Material. 13 specimens.

### *Distacodus stola* n. sp.

Pl. 3, figs. 43—49.

Derivatio nominis. *Stola*, Lat. = long skirt.

Holotype. LO 3631 T, pl. 3, fig. 45.

Diagnosis. A *Distacodus* with very long, narrow, laterally compressed base and rather high, thin costae and keels.

Description. The basal cavity may extend a little into the cusp. Its sheath is very thin. The anterior and oral edges of the base are more or less straight and do not diverge at more than 30°. The whole base is laterally compressed.

The cusp is erect or proclined or slightly recurved. As a rule, it is very small.

The keels and the two, or rarely three, costae take their origin on the cusp and may get rather high on reaching the base. They are very thin and translucent. Sometimes they may develop a few denticles. As a rule, the keels and costae are placed symmetrically. Either of the lateral faces may, however, fail to develop a costa. Then, the oral keel gradually curves over to the lateral face in question and the other ateral face develops an additional costa that may ultimately replace the oral keel towards the aboral margin. This stage has not quite been reached in pl. 3, figs. 43, 44.

Occurrence. The holotype is from the U. Pl. Ls. of Bjällum, sample 4. The species is rather common in the U. Pl. Ls.

Material. 90 specimens.

### *Distacodus stola* n. sp. var. *latus* nov.

Pl. 3, figs. 50, 51.

Derivatio nominis. *Latus*, Lat. = wide.

Holotype. LO 3635 T, pl. 3, figs. 50, 51.

Diagnosis. Like *Distacodus stola*, but anterior and oral edges of base diverge at c 90°.

Description. The anterior and posterior margins of the basal cavity are concave. So is the aboral margin. The oral and anterior edges of the base diverge at about right angles.

The cusp is suberect and not very strong. The anterior and oral edges are high and thin, whereas the lateral costae are rather weak. The whole tooth may be slightly curved in a lateral direction.

Occurrence. The holotype is from the U. Pl. Ls. of Yxhult, ection II, sample 7. The variety is very rare in the U. Pl. Ls.

Material. 10 specimens.

### *Drepanodus* PANDER, 1856.

Type species. *Drepanodus arcuatus* PANDER, 1856.

Pander's description (translated from PANDER 1856, p. 20). 'More or less curved pointed teeth with anterior and posterior qually strong sharp keels and convex, smooth, symmetrical lateral urfaces. According to the different curvature the following forms can be distinguished.'

Remarks. If one choses to follow Pander's definition all costate or strongly sulcate specimens must be excluded from the genus, as must the markedly unsymmetrical forms. Thus, *Drepanodus lineatus* FURNISH, 1938, p. 328 might better be regarded as an *Acodus*.

It has been a general tendency to regard all species fitting to Pander's definition of *Drepanodus* but with the base markedly wider than the cusp as belonging to the genus *Oistodus*. I will discuss this matter more closely under that genus. Suffice it here to state that relative width of the base is a most subjective character, and that the *Drepanodus* spp. depicted in Pander's pl. 1, figs. 2, 6, 7, 8 have as wide a base as many an '*Oistodus*'. There is, in fact, a complete gradation from such relatively narrow-based forms as *Drepanodus arcuatus* via *D.* cf. *arcuatus*, *D. homocurvatus* and *D. amoenus* to such a wide-based form as *D. sculponea*. Also, as will appear in the description of that species, *D. sculponea* is directly derivable from *D. arcuatus*.

I have regarded all symmetrical or sub-symmetrical species with smooth lateral faces, sharp anterior and posterior edges, and the posterior edge of the cusp meeting the oral margin in a curve, as belonging to *Drepanodus*.

### *Drepanodus amoenus* n. sp.

Pl. 2, figs. 25, 26, textfig. 4 b.

Derivatio nominis. *Amoenus*, Lat. = pleasant.

Holotype. LO 3579 T, pl. 2, fig. 26.

Diagnosis. A *Drepanodus* with rather strongly recurved cusp, rather wide and laterally compressed base and rather deep basal cavity with rounded outlines.

Description. The basal cavity is about as deep as in *D. homocurvatus*. It is not triangular in outline, but like a phrygian cap, with its point bent forwards. Its outlines are markedly curved. The oral edge of the base is sharp and can vary in length. The aboral margin is curved, either evenly or the most strongly posteriorly. The anterobasal angle usually is less than 90°. It is thin and may be more or less deflexed.

The cusp is rather strongly recurved. It is not very sharply offset from the base posteriorly. Its lateral faces are slightly rounded, often with depressions near the edges. The anterior and posterior edges are sharp.

There may be basal canalules.

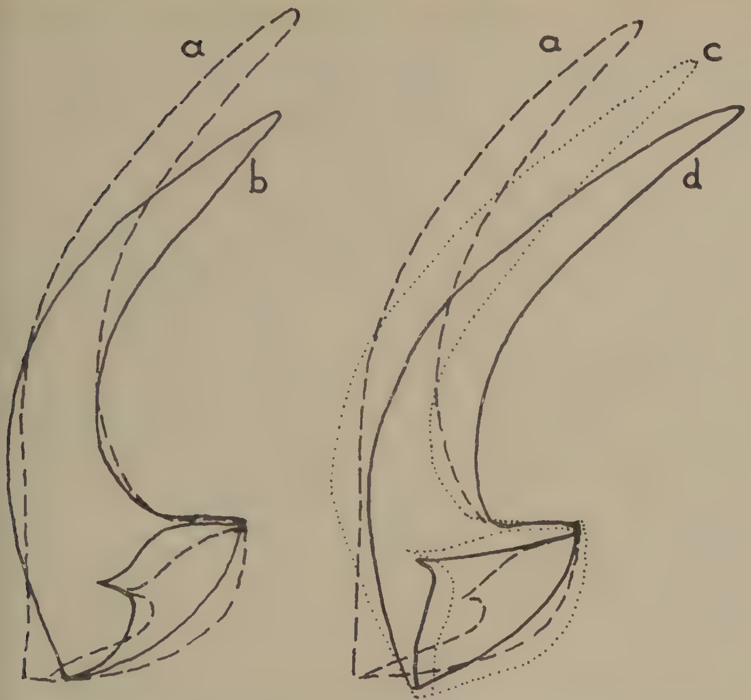
Occurrence. The species is common in the Ce. zone of Stora Backor. The holotype is from sample 5.

Material. 75 specimens.

### *Drepanodus arcuatus* PANDER, 1856.

Pl. 2, figs. 30—33, textfig. 3 J.

1856. *Drepanodus arcuatus* PANDER, p. 20, pl. 1, figs. 4, 5 (not figs. 2,17, 30, 31).



;. 4. Comparison between *Drepanodus planus* n. sp. (a), *D. amoenus* n. sp. (b), *D.* cf. *arcuatus* PANDER (c) and *D. homocurvatus* n. nom. (d). Approximately 100 ×.

?1933. *Oistodus pandus* BRANSON & MEHL, p. 61, pl. 4, fig. 22 (not fig. 21).
?1938. *Oistodus pandus* BRANSON & MEHL — Furnish, p. 330, pl. 42, fig. 5.
?1941. *Oistodus pandus* BRANSON & MEHL — GRAVES & ELLISON, pl. 1, fig. 31 (not pl. 1, figs. 2, 34, pl. 2, fig. 34).
t 1879. *Drepanodus arcuatus* PANDER — HINDE, p. 357, pl. 15, figs. 7, 8 (see BRANSON & MEHL 1933, p. 153, pl. 12, figs. 12, 13).
t 1933. *Drepanodus arcuatus* BRANSON & MEHL, p. 58, pl. 4, fig. 13.
t 1953. *Drepanodus arcuatus* PANDER — RHODES, p. 292, pl. 21, fig. 110.

This species seems to require a redescription.

I have got a large number of specimens that are identical with Pan-
r's figs. 4, 5, pl. 1, and I think that one can safely exclude from the
ecies all conodonts that do not agree with these figures. At any rate,
s requires a discussion. In the first place, the accuracy of Pander's
awings seems to be great. Minute details are recorded, and whenever

one can identify one of Pander's species, the identity is complete. If, then, his drawings can be trusted, the specimens represented by his pl. 1, fig. 2, figs. 4, 5, fig. 17 and figs. 30, 31 belong to four distinct species. The conception of *Drepanodus arcuatus* will depend on which of these is selected to typify the species. Hinde's specimens vaguely resemble Pander's fig. 2. They are, however, less strongly recurved and far more drawn-out antero-basally. I do not think that there is any identity. Rhodes figures a *Drepanodus* that is not identical with any of Pander's figures. I therefore believe that I am justified in regarding the kind of *Drepanodus* found by me as typical of *Drepanodus arcuatus*. If this be not entirely satisfactory from a taxonomic point of view, it seems at least practical for the present.

The basal cavity is almond-shaped in cross section, widest orally. It first curves away from the anterior margin, then curves anteriorly so that its sharp point is quite near the anterior margin of the tooth. Between the cavity and the straight anterior margin there is thus a sickle-shaped solid segment that is very thin and usually somewhat deflected laterally, as in *Acontiodus arcuatus*.

The oral margin is rounded or faintly keeled. In lateral view it is slightly convex or almost straight, as appears quite distinctly in Pander's pictures. The aboral margin is straight or undulated at one side. It makes an angle of c 45° with the oral margin. The basal stretch of the anterior margin, as mentioned above, is straight and sub-parallel to the oral margin.

The cusp is recurved. As a rule it is long and slender. Its lateral faces are rather well rounded. The anterior and posterior keels are weak or absent.

Basal canalules are quite common.

Occurrence. The species is rather common throughout the sequence of strata investigated, mostly so in the L. Pl. Ls. Probably, Öpik is right in recording it from the Dictyonema Shale ($A_3$) of Rågö (Öpik 1927, p. 39).

Material. 410 specimens.

### *Drepanodus* cf. *arcuatus* Pander, 1856.

Pl. 2, figs. 45, 46, textfig. 4 c.

1941. *Oistodus curvatus* Branson & Mehl — Graves & Ellison, pl. 1, fig. 8.

This is a very difficult group of simple conodonts. I first placed it with *Drepanodus homocurvatus*, then thought better of it and conferred it to *D. arcuatus*. The bulk of the specimens differ from that species, too.

The basal cavity is rather deep and wide. Its outlines are curved, d its apex points forward. The oral edge is rather sharp and slightly nvex in side view. The aboral margin may have a rather strong dulation on one side, as in *D. arcuatus*. The basal stretch of the terior margin is straight, flange-like, and mostly strongly deflexed. s a whole the base is higher than in *D. homocurvatus* (cf. textfig. 4) t shorter than in *D. arcuatus*.

The cusp is less strongly recurved above the base than in *D. homo-rvatus*. Its lateral faces are rounded. It is more or less sharp-edged teriorly and posteriorly.

Occurrence. These conodonts are rather common in the Pl. Ls. he specimen figured by Graves & Ellison from the lower part of e Marathon formation probably belongs here.

Material. 141 specimens.

### *Drepanodus conulatus* n. sp.

Pl. 2, fig. 34, pl. 4, fig. 34.

Derivatio nominis. *Conulatus* refers to the conical basal vity.

Holotype. LO 3662 T, pl. 4, fig. 34.

Diagnosis. A *Drepanodus* with wide, conical basal cavity and berect, rather wide, thin, blade-like cusp.

Description. The basal cavity is sub-circular in cross section d widest anteriorly. It is sharply conical. The oral margin is straight lateral view. It is rounded, but anteriorly it may carry a low, sharp el. The aboral margin is straight or slightly indented in side view. he basal stretch of the anterior margin is also straight in side view. ike the oral margin it is rounded and may be faintly keeled.

The cusp is slightly recurved, but the very conspicuous growth axis erect. The lateral faces are little rounded. The anterior and posterior ges are sharp. The whole of the blade may be slightly twisted.

Commonly, there are beautiful basal canalules.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, mple 7. The species is very rare in the strata below the Lb. Ls.

Material. 36 specimens.

### *Drepanodus cyranoicus* n. sp.

Pl. 5, fig. 8.

Derivatio nominis. The cusp looks like an enormously ng and somewhat aquiline human nose, a feature said to distinguish . Cyrano de Bergerac.

Holotype. LO 3677 T, pl. 5, fig. 8.

Diagnosis. A *Drepanodus* with widely flaring and shallow base and erect and straight-edged, broad, thin cusp.

Description. The basal cavity is widely flaring and shallowly conical. The oral margin is rounded, short and straight. The aboral margin is long and diverges from the oral margin at a low angle. Anteriorly, it is undulated at both sides, so that the whole of the base is slightly arched. The anterior margin is bent forward at the base.

The cusp is erect. Its growth axis is clearly visible, white, rod-like and straight, as in *Drepanodus conulatus* and *Paltodus furnishi*. Its lateral faces are little rounded. Its posterior edge is quite straight. The anterior edge is bent backwards some distance above the base, then forwards again at the base. Both edges are sharp.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, sample 7. Three other specimens were found, one in the L. and two in the U. Pl. Ls.

### *Drepanodus deltifer* n. sp.

Pl. 2, figs. 42, 43.

Derivatio nominis. The species carries a deltoid basal cavity.

Holotype. LO 3594 T, pl. 2, fig. 43.

Diagnosis. A thin, slightly recurved, sharp-edged *Drepanodus* with a big, laterally compressed, equilaterally triangular base.

Description. The basal cavity is rather deep and laterally compressed. In outline, it is an equilateral triangle with concave edges. The oral edge of the base is sharp and straight or concave in lateral view. The aboral margin as a rule is straight. The basal stretch of the anterior margin leans posteriorly.

The cusp is slightly recurved, rather thin and slender, and sharp-edged. Occasionally, there is a thin costa on one side.

Occurrence. The holotype is from the Ce. zone of Stora Backor, sample 5. The species is rather common in the Ce. strata and next above.

Material. 31 specimens.

### *Drepanodus? gracilis* (Branson & Mehl, 1933).

Pl. 4, fig. 44, pl. 5, figs. 6, 7.

1933. *Oistodus gracilis* Branson & Mehl, p. 60, pl. 4, fig. 20.

My specimens agree with Branson & Mehl's description and figure in all respects, except that the two depressions defining the posterior keel may occasionally be so deep as to produce the *Acontiodus* cross section, and that the base may be somewhat unsymmetrical (pl. 5, figs. 6, 7), hence the mark of interrogation at the genus.

Occurrence. The species is rare in the Pl. Ls. Branson & Mehl und it in the Jefferson City formation of Missouri. Graves & Ellin (1941, p. 4, pl. 1, figs. 26, 30, 33, pl. 3, fig. 16) claim to have found in the Ordovician of the Marathon basin, Texas.

Material. 44 specimens.

### *Drepanodus homocurvatus* n. nom.

Pl. 2, figs. 23, 24, 39, textfig. 4 d.

ot 1932. *Drepanodus curvatus* Stauffer, p. 259, pl. 40, fig. 1.
1933. *Oistodus curvatus* Branson & Mehl, p. 110, pl. 9, figs. 4, 10, 12.
1935 a. *Oistodus curvatus* Branson & Mehl — Stauffer, p. 146, pl. 12, figs. 20, 23, 24, 27, 29, 30, 36.
1935 b. *Oistodus curvatus* Branson & Mehl — Stauffer, p. 609, pl. 74, figs. 5, 10, 12, 17, 20—23, 25—29, 31, 33—40, 47—49.
1941. *Oistodus curvatus* Branson & Mehl — Graves & Ellison, pl. 3, fig. 17.
1953. *Oistodus curvatus* Branson & Mehl — Rhodes, p. 295, pl. 21, figs. 89?, 90?, pl. 22, figs. 157?, 158?, 159?, 160, 161?.

Derivatio nominis. The name *Drepanodus curvatus* being eoccupied by Stauffer, *Oistodus curvatus* on being referred to *Drepalus* must be renamed. In accordance with the proposal of Triebel & Richter (1943, p. 323) I have added the stereotype prefix *homo* — the specific name.

Description. My specimens agree rather well with Branson & hl's description and even better with the specimens figured by auffer, 1935 a & b.

The basal cavity is rather deep and wide, roughly triangular in line, and with its apex pointing backward. The oral edge is sharp l straight. The aboral margin as a rule is smoothly and evenly curved. e basal stretch of the anterior edge runs at about right angles to oral edge.

The cusp is rather strongly recurved. It is more or less sharply offset m the base posteriorly. It is long and slender. Its lateral faces are l rounded. Occasionally one of them may, however, be flattened l depressed at the edges, mostly so at the anterior edge. The edges erally are distinctly offset and sharp. The anterior edge may be lexed.

Occurrence. The species is common in strata above the Ce. e.

Material. 300 specimens.

### *Drepanodus latus* n. sp.
Pl. 3, figs. 22, 23.

Derivatio nominis. *Latus*, Lat. = wide, referring to the wide base.

Holotype. LO 3615 T, pl. 3, fig. 23.

Diagnosis. A *Drepanodus* with wide and long, laterally compressed base and rather small cusp.

Description. The basal sheath is thin and smooth. The oral and anterior margins of the base are straight or nearly so, developed as rather high and thin keels and diverging at 30°—60°.

The cusp is thin and slender, proclined or suberect, and somewhat curved.

Occurrence. The holotype is from the L. Pl. Ls. of Stora Backor. sample 8. The species is rare in the L. Pl. Ls.

Material. 12 specimens.

### *Drepanodus longibasis* n. sp.
Pl. 3, fig. 31.

Derivatio nominis. The name refers to the unusually long base of the species.

Holotype. LO 3621 T, pl. 3, fig. 31.

Diagnosis. A slender *Drepanodus* with the cusp erect and the base narrow and almost as long as the cusp.

Description. The basal cavity is conical, much longer than wide. The oral margin of the base is rounded and un-keeled. The aboral margin is almost straight in side view. The basal stretch of the anterior margin is subparallel to the oral margin, rounded and un-keeled.

The cusp is rather sharply bent upwards and is then erect. Except at the basal bend it is thin and blade-like, with sharp anterior and posterior edges.

Occurrence. The holotype is from the U. Pl. Ls. of Lanna, sample 12. The species is very rare in the upper part of the U. Pl. Ls.

Material. 12 specimens.

### *Drepanodus numarcuatus* n. sp.
Pl. 2, figs. 48, 49, textfig. 3 I.

Derivatio nominis. *Num arcuatus?*, Lat. = this, I presume, is not an *arcuatus*.

Holotype. LO 3600 T, pl. 2, fig. 49.

Diagnosis. A slightly recurved *Drepanodus* with the cusp thickest anteriorly and the base narrow antero-posteriorly. Basal cavity rather shallow.

Description. The basal cavity is rather wide and shallow. It deepest and widest posterior to its point. The latter is slightly curved wards. The oral margin is rather long, straight or convex in lateral w. It is keeled, but the keel does not reach the posterior corner. e aboral margin is almost straight in lateral view. It makes an angle 45°—75° with the oral margin. The basal stretch of the anterior rgin is curved backward so as to run at a low angle to the direction the oral margin.

The cusp is slightly recurved or suberect. Its lateral faces are rounded, ecially near the anterior margin where the cross section of the th is thus the widest. The anterior and posterior edges are sharp. e anterior edge may be strongly flexed laterally.

Remark. Pander would, I suppose, have regarded this species a *Distacodus*. In the absence of true lateral costae I have hesitated do so. I admit that another reason why I brought it to *Drepanodus* its similarity to *Drepanodus arcuatus*. The two species differ mainly the cross section of the cusp.

Occurrence. The species is rather common in the Ce. zone of ra Backor. The holotype is from sample 5.

Material. 35 specimens.

### *Drepanodus planus* n. sp.

Pl. 2, figs. 35—37, textfig. 4 a.

53. *Oistodus curvatus* Branson & Mehl — Rhodes, pl. 21, figs. 82, 83.

erivatio nominis. *Planus*, Lat. = flat.

olotype. LO 3588 T, pl. 2, fig. 37.

iagnosis. A moderately recurved *Drepanodus* with little nded lateral faces, wide, laterally compressed base and shallow basal ity.

escription. The basal cavity is shallow, especially anteriorly. apex is strongly bent forwards. The oral edge is sharp and straight. nay be very short. The aboral margin is strongly curved posteriorly, as a rule it is straight and parallel to the oral edge anteriorly. The ero-basal angle generally is slightly less than 90°.

he cusp is slightly recurved. It is not sharply offset from the base teriorly. Its lateral faces are almost flat. The posterior and anterior es are sharp. The anterior edge may be deflexed laterally.

asal canalules are not uncommon.

emarks. It may seem difficult and unnecessary to separate species from *D. homocurvatus*. The stratigraphic realm of the two cies does not, however, quite coincide. They are distinguished by the more rounded lateral faces of *D. homocurvatus* and by the sharper antero-basal angle and shallower basal cavity of *D. planus*. *D. planus* differs from *D. amoenus* in being less recurved and possessing a shallower basal cavity the outlines of which are straighter (textfig. 4).

Occurrence. The holotype is from the U. Pl. Ls. of Lanna, sample 10. The species is abundant in the U. Pl. Ls. and the strata next above.

Material. 775 specimens.

### *Drepanodus proteus* n. sp.

Pl. 3, figs. 18—21, textfig. 2 a—f, j.

?1941. *Oistodus pandus* BRANSON & MEHL — GRAVES & ELLISON, pl 1, fig. 34.

Derivatio nominis. Like *Proteus*, the species can take on several shapes.

Holotype. LO 3612 T, pl. 3, fig. 20.

Diagnosis. A *Drepanodus* with the recurved basal cavity at the posterior end of the base and basal cavity inverted anteriorly.

Description. This is a highly variable species that may be very like *Oistodus parallelus* on one hand, *Distacodus expansus* on the other.

The basal cavity as a rule is more or less compressed laterally but may flare widely. It is rounded in outline. Its sharp point is near the aboral margin of the base, and behind the point there is but a short and shallow extension of the cavity. The oral edge of the base is sharp, usually straight and rather long. The aboral margin posteriorly makes an angle of c 45° with the oral edge. In most specimens (e. g. the holotype) it then bends and on reaching the antero-basal angle is subparallel to the oral edge. The bend at the middle of the aboral margin may also be stronger, and the specimens then resemble *Oistodus parallelus* (compare pl. 3, fig. 21 with pl. 4, fig. 29). Also, there may be no bend at all, the whole of the aboral margin being considerably shortened, as in pl. 3, fig. 19.

The antero-basal angle is about 90°. At the angle, the tooth is very thin. This thin flange of the tooth may be more or less strongly bent laterally. In some specimens the anterior margin is bent sideways all along the cusp. As a further development, some very rare specimens have developed an extra anterior keel to replace the one that is bent laterally (textfig. 2 a—c).

The cusp is rather long and slender, reclined, recurved or, very rarely, suberect. Its lateral faces are rounded, and it is keeled posteriorly and anteriorly.

Along the anterior part of the aboral margin the growth lamellae :ede in the way already described in *Acontiodus rectus*. Here, however, e feature is regularly occurring. Textfig. 2 j illustrates the structure the striated zone thus formed. The successively younger growth nellae leave a narrow zone of the next older ones uncovered.

In one or two specimens there seem to be basal canalules.

Occurrence. The holotype is from the L. Pl. Ls. of Yxhult, ction II, sample 3. The species is very common in the L. Pl. Ls. and curs but rarely in higher strata.

Material. 321 specimens.

### *Drepanodus sculponea* n. sp.

Pl. 2, fig. 40, textfig. 3 L.

933. *Oistodus pandus* Branson & Mehl, pl. 4, fig. 21.

Derivatio nominis. *Sculponea*. Lat. = wooden shoe.

Holotype. LO 3591 T, pl. 2, fig. 40.

Diagnosis. A recurved, rather robust *Drepanodus* with the ep, laterally compressed basal cavity sending a shallow extension ther far anteriorly.

Description. The basal cavity is deep and laterally compressed. s outlines are rounded. Its apex is directed anteriorly. Anterior to e apex there is a shallow extension of the cavity, as in *Acontiodus* *linatus*. The oral edge may be rather sharp. Posteriorly, the aboral argin leaves the oral edge at about right angles, then curves so that anterior half is subparallel to the oral edge. The basal stretch of e anterior edge as a rule is slightly recurved. At the antero-basal gle the base may be very thin, especially if, as in the holotype, the terior margin is not recurved basally.

The cusp is rather strongly recurved. Posteriorly, it is sharply offset m the base. Its lateral faces are well rounded. Its edges are sharp d may be keel-like.

There may be beautiful branching basal canalules. A thin strip of erted basal cavity may be observable at the antero-basal angle.

Remarks. The species can be derived from *Drepanodus arcuatus*, l intermediate forms do occur. The description refers to the bulk the specimens grouped under *D. sculponea*. *D. sculponea* differs from *planus* i. a. in being more robust and more recurved and in having nuch deeper basal cavity.

)ccurrence. The holotype is from the L. Pl. Ls. of Latorp, nple 5. The species is more or less common in all the strata investited.

Material. 221 specimens.

### *Drepanodus* cf. *subarcuatus* Furnish, 1938.
Pl. 2, figs. 41, 44, 50.

?1933. *Drepanodus arcuatus* Branson & Mehl, p. 58, pl. 4, fig. 13.
?1938. *Drepanodus subarcuatus* Furnish, p. 328, pl. 41, figs. 25–32, pl. 42, figs. 2, 3, textfig. 1 F, G, p. 332.

These specimens are not as translucent as the others.

The basal cavity appears to be conical and rather deep, its point anteriorly. It widens considerably posteriorly. The oral margin is rounded and faintly keeled. It is straight. The aboral margin is nearly straight, but it may also be slightly concave or convex. It makes an angle of c 45° with the oral margin. The basal stretch of the anterior edge is smoothly curved forwards.

The cusp is suberect or slightly reclined or recurved. Its lateral faces are well rounded. Anteriorly and posteriorly it is keeled. The surface of the tooth may be finely striated.

Remarks. There seems to be little difference between this species and *D. subarcuatus* of the Prairie du Chien beds of Minnesota.

Occurrence. The species is rare in the Ce. strata of Stora Backor. A few specimens were found in higher strata.

Material. 13 specimens.

### *Drepanodus suberectus* (Branson & Mehl. 1933).
Pl. 2, figs. 21, 22.

1933. *Oistodus suberectus* Branson & Mehl, p. 111. pl. 9. fig. 7.

My specimens agree in all respects with the description given by Branson & Mehl.

Occurrence. The species is rather uncommon in the U. Pl. Ls. and the Lb. Ls. Two specimens were found in the L. Pl. Ls. Branson & Mehl described it from the Plattin formation of Missouri. In N. America it ranges from U. Beekmantown (U. Marathon fm. of Texas, Graves & Ellison 1941, pp. 4, 7, pl. 1, fig. 32) to Richmond (Waynesville and Liberty fms. of Indiana, Branson, Mehl & Branson 1951, p. 8, pl. 2, figs. 1—4).

Material. 67 specimens.

### *Falodus* n. gen.

Derivatio nominis. After Falbygden (the 'Fala Country') where the Stora Backor and Tomten sections are situated.

Type species. *Oistodus prodentatus* Graves & Ellison, 1941.

Definition. Compound conodonts with two basal processes, one anteriorly, with denticles, and one posteriorly, without. There are no other processes or definite costae.

### *Falodus prodentatus* (Graves & Ellison, 1941).
Pl. 5, figs. 21, 22, 30.

41. *Oistodus prodentatus* Graves & Ellison, p. 13, pl. 2, figs. 6, 22, 23, 28.

My specimens agree in all respects with the description given by ᴀᴠᴇs & Ellison.

Occurrence. The species is very rare in the U. Pl. Ls. of Väsgötland. It occurs in the Fort Peña and Woods Hollow formations Texas.

Material. 10 specimens.

### *Gothodus* n. gen.

Derivatio nominis. The *Gothi* are said to have populated uth-Central Sweden.

Type species. *Gothodus costulatus* n. sp.

Definition. The genus *Gothodus* realizes the combination three ocesses or definite costae, two of which are undenticulated. The rd costa runs into the denticulated oral margin.

Remark. *Cordylodus plattinensis* Branson & Mehl, 1933 (p. 7, pl. 8, figs. 34, 36) may belong here.

### *Gothodus costulatus* n. sp.
Pl. 5, figs. 23—25.

Derivatio nominis. The species is provided with a thin sta.

Holotype. LO 3690 T, pl. 5, figs. 23, 24.

Diagnosis. A *Gothodus* with inconspicuous undenticulated proces, fused, laterally compressed denticles and high, slender, suberect p.

Description. The basal cavity is conical and runs into a sharp that is close to the anterior margin. The base is drawn-out posterly into a short denticulated bar into which the cavity continues. The cusp is very long and slender. On leaving the base it is proclined, n curves upward to become erect.

There are two undenticulated costae. One of them runs along the erior margin. The other that may not extend up the cusp adorns a eral face. The denticulated oral edge is rather short. The denticles somewhat narrow and are fused at their bases.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, nple 7. The species is very rare in the U. Pl. Ls. of Västergötland.

Material. 10 specimens, two of which are questionable.

### *Nericodus* n. gen.

Derivatio nominis. After *Nericia*, Lat. for Närke.

Type species. *Nericodus capillamentum* n. sp.

Definition. Dome-shaped conodonts with numerous, mostly irregularly distributed little nodes that may fall into winding rows but are never developed as rows of denticles. There is a basal cavity, however shallow.

### *Nericodus capillamentum* n. sp.

Pl. 6, figs. 41, 42.

Derivatio nominis. *Capillamentum*, Lat. = wig.

Holotype. LO 3736 T, pl. 6, figs. 41, 42.

Diagnosis. A strongly arched *Nericodus* with deep basal cavity, deepest at one end of the arch, and one lateral face nearly smooth.

Description. If the unit be taken to be elongated antero-posteriorly and arched in lateral view, the following applies.

The basal cavity is deep, deepest anteriorly. One lateral face is bordered by a row of closely crowded nodes but for the rest is almost smooth. The rest of the unit is ornamented by rather strong, irregular nodes that may unite to form branching and winding ridges.

Remarks. One specimen only is found, the holotype.

Occurrence. L. Pl. Ls. of Yxhult, section II, sample 4.

### *Oepikodus* n. gen.

Derivatio nominis. In honour of Dr. ARMIN ÖPIK.

Type species. *Oepikodus smithensis* n. sp.

Definition. Compound conodonts with a cusp and one anterior, undenticulated process, one posterior denticulate process and to each side a lateral undenticulate process, however weak.

### *Oepikodus crassulus* n. sp.

Pl. 5, figs. 36, 37.

Derivatio nominis. Diminutive of Lat. *crassus* = stout.

Holotype. LO 3698 T, pl. 5, fig. 36.

Diagnosis. An *Oepikodus* with a few strong denticles, angular, proclined cusp, strong lateral extensions and scarcely any free processes.

Description. The basal sheath being wide and almost completely connecting the edges, the basal cavity is deep. The base is diamond-shaped in cross section. The edges do not diverge very much. The oral edge carries a few stout, proclined denticles.

The cusp, too, is diamond-shaped in cross section. It is rather long, proclined and somewhat curved.

A slightly aberrant specimen from the Lb. Ls. of Stora Backor, nple 19. is shown in pl. 5, fig. 37. In it, the denticles are bigger, the terior and posterior edges more divergent, the lateral extensions not wide, and the cusp almost erect.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, nple 6. The species is very rare in the U. Pl. Ls. One specimen in Lb. Ls.

Material. 8 specimens.

*Oepikodus smithensis* n. sp.
Pl. 6, figs. 1—3.

Derivatio nominis. After the Scottish amateur paleontol- ist John Smith.

Holotype. LO 3709 T, pl. 6, fig. 3.

Diagnosis. An *Oepikodus* with very long, slender, nearly straight sterior process with irregular, crowded denticles. Small lateral proc- es begin as costae on the cusp. Anterior process long, straight, ttened, bent backwards. Cusp long, slender, suberect, slightly curved.

Description. The basal cavity is very narrow. It may be rerted along the processes.

The posterior process as a rule is broken off. It must have been ry long. In lateral view it is almost straight, but it may undulate ittle laterally. It is strongly flattened and rather high. The denticles numerous, crowded, mostly small, and erect. At irregular intervals ere may be a bigger denticle that causes the oral edge to bulge strongly one side. All the denticles are fused basally. They are rounded in oss section and rather sharp. The anterior denticles are crowded up ainst the cusp.

The lateral processes are low and project but little. They arise as stae high up the cusp. In a few specimens the lateral processes are a stronger, and in one case they even carried a couple of barely dis- guishable denticles.

The anterior process is about as long as the cusp. It is a straight ntinuation of the oblique backward direction of the basal part of cusp. It is flattened laterally, and its point is rounded.

The cusp is thin, long and suberect or proclined. It is somewhat rved. Along each of its lateral faces there runs a costa.

In one case a small specimen was closely appressed with its cusp l anterior process to the anterior process of a bigger specimen, the sterior processes parallel. This may be accidental.

Remarks. If Smith was correct in the following points (Smith 07, p. 249. pl. 8, figs. 36, 38, 39, 41, 42), 1) in regarding *Prioniodus latus* Smith, *P. equalis* Smith and *P. Macconochii* Smith as separate species, 2) in figuring the posterior process in these species as rathe narrow, 3) in indicating the bigger denticles to be regularly spaced in *P. inflatus* and *P. Macconochii* and 4) in letting the anterior proces be very narrow and pointed, then my species is distinct from all o these. If not, and I admit this to be a possibility, my species is a junio synonym of any of Smith's species chosen to include the rest. Smith' types seem to have disappeared with little hope of being found again At any rate, the possibility of *Oepikodus smithensis* being a junio synonym of one of Smith's species will not affect the status of th genus *Oepikodus.*

Occurrence. The holotype is from the base of the U. Pl. Ls of Yxhult, section II, sample 7. The species is very common in th basal part of the U. Pl. Ls.

Material. 281 specimens.

## *Oistodus* PANDER, 1856.

Type species. *Oistodus lanceolatus* PANDER, 1856.

Pander's description (translated from PANDER 1856. p 27). 'A small subdivision is formed by those simple teeth that res upon a very wide and long excavated base and out of which we at firs make but a single genus, the characters of the different forms agreein very much with one another. As a rule, they are translucent, yello and of horny appearance, yet carbonatic.'

Remarks. The two characters mentioned by PANDER are tha these are simple teeth, and that the base is strongly expanded. Thus it is not advisable to include denticulated species in the genus. *Oistodu prodentatus* is a contradictio in adjecto.

The second character has been heavily stressed in later works A rather heterogeneous assemblage of species with expanded base ha been included in the genus. RHODES (1953 b, p. 293) figures what ha come to be regarded as a typical *Oistodus*. This *Oistodus* concept differ from Pander's *Oistodus* spp. chiefly in the absence of carinae on th lateral faces and in that the posterior edge does not make a shar angle with the oral edge.

PANDER states that the characters of his *Oistodus* spp. agree ver much with one another and that this is why he has grouped the under one genus. The most striking characters in which his *Oistodu* spp. agree are, in fact, the presence of carinae on both or either o the lateral faces and the sharp angle formed where the posterior an oral edges meet.

In any or both of these respects they agree with i. a. the followin species published at a later date, *Oistodus inclinatus*, *O. abundans* an

*O. breviconus* BRANSON & MEHL, 1933, *O. venustus* STAUFFER, 1935 a and *O. excelsus* and *O. fornicalus* STAUFFER, 1935 b.

As stated under that genus, the bulk of the remaining *Oistodus* spp. can profitably be brought to *Drepanodus*. The genus *Oistodus* might be redefined as follows.

Redefinition. To *Oistodus* belong simple conodonts with a more or less wide basal cavity. The posterior edge makes a sharp angle with the oral edge. As a rule, either or both of the lateral faces are carinate.

### *Oistodus contractus* n. sp.

Pl. 4, figs. 45, 46, textfig. 3 H.

Derivatio nominis. *Contractus* refers to the unusually short base.

Holotype. LO 3671 T, pl. 4, figs. 45, 46.

Diagnosis. A rather strongly reclined *Oistodus* with roughly rectangular base and very short oral edge.

Description. The basal cavity is rather shallow and wide. It extends as such from the oral edge to the antero-basal angle, following the bend of the aboral margin. The oral edge is very short, straight and sharp. The aboral margin posteriorly runs subparallel to the anterior edge, then bends and makes a right angle with the anterior edge. The base may be slightly unsymmetrical.

The cusp is strong and reclined, as a rule more reclined than indicated in the figures. Its lateral faces are rounded. The edges are keeled.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, sample 7. The species is very rare in the U. Pl. Ls. and above.

Material. 13 specimens.

### *Oistodus delta* n. sp.

Pl. 3, figs. 3—9.

Derivatio nominis. After the deltoid anterior surface.

Holotype. LO 3603 T, pl. 3, figs. 5—7.

Diagnosis. A robust *Oistodus* with the lateral carinae standing out like wings and a very faint keel anterior to them, so that a deltoid anterior surface is formed.

Description. The basal cavity is shallow and thick-rimmed. It extends as grooves into the lateral wings. The aboral margins of the wings and of the posterior extension of the base are in the same plane. The oral edge is marked by a high, sharp and curved keel.

The cusp is erect or slightly proclined. It is widely expanded laterally, whereas the posterior and anterior keels are rather low or almost absent, respectively. The cusp is widest basally and tapers evenly towards the apex, so that the resulting anterior surface is deltoid in outline. Basally, the anterior surface curves backward.

The posterior extremity of the holotype is thickened laterally into a little trefoil-shaped knob.

Remarks. An *Oistodus* like *O.* n. sp. (pl. 3, fig. 26) will be transformed into *O. delta* if its anterior keel is considerably reduced.

Occurrence. The holotype is from the U. Pl. Ls. of Yxhult, section II, sample 7. The species is rather rare in the U. Pl. Ls.

Material. 18 specimens.

### *Oistodus elongatus* n. sp.

Pl. 4, figs. 32, 33, textfig. 5 b.

Derivatio nominis. From the very long cusp.

Holotype. LO 3661 T, pl. 4, fig. 33.

Diagnosis. An *Oistodus* with long, slender, suberect cusp and wide, thin-sheathed, laterally compressed base.

Description. The basal cavity is deep, antero-posteriorly wide and laterally compressed. Its sheath is very thin. The oral edge is marked by a long keel that is straight, thin and rather high. The same is the case with the anterior edge. The two keels diverge at almost 90°. The aboral margins forms a wide, concave curve.

The cusp is long and slender, suberect and slightly recurved. Its posterior edge meets the oral edge at an angle that is about 90°. Its lateral faces carry blunt, indistinct carinae, so that the cross section is nearly diamond-shaped. Its edges are sharp.

Remarks. This description applies to the specimens from the boundary strata of the L. and U. Pl. Ls. at Skultorp and Lanna. Three specimens from the lower part of the L. Pl. Ls. of Ulunda and Latorp might be referred to as *Oistodus* aff. *elongatus* (textfig. 5 b). They carry distinct lateral carinae, and the cusp is slightly reclined.

Occurrence. The holotype is from the L. Pl. Ls. of Lanna sample 5. The species is very rare in the L. Pl. Ls. and next above.

Material. (In all) 10 specimens.

### *Oistodus forceps* n. sp.

Pl. 4, figs. 9—13, textfig. 3 M.

Derivatio nominis. *Forceps*, Lat. = pincers, referring to the similarity between this conodont and the pincers of a crustacean

Holotype. LO 3646 T, pl. 4, figs. 9, 10, 13.

Diagnosis. An *Oistodus* with posteriorly drawn-out base and still longer, strongly reclined, slightly laterally flexed cusp.

Description. The basal cavity extends all along the base to the antero-basal angle where it is usually rather shallow and slightly

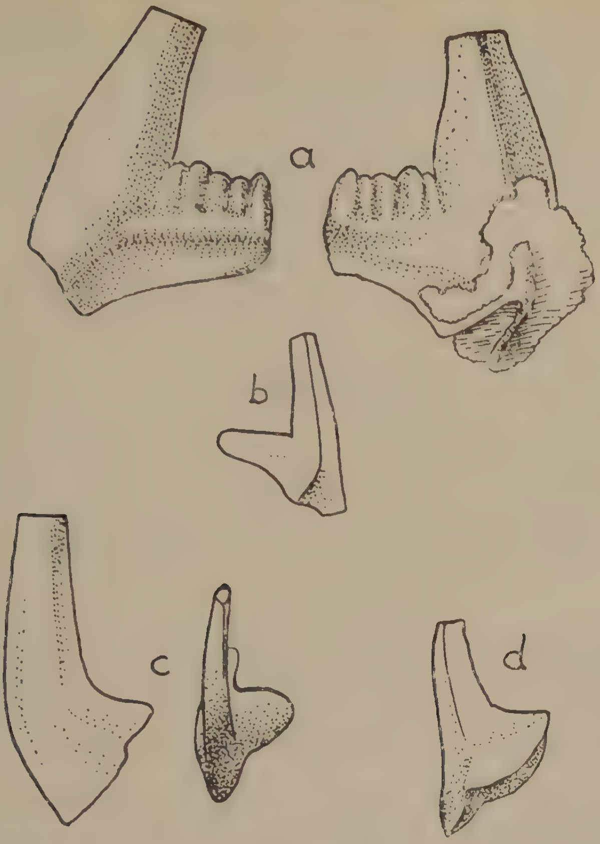


Fig. 5. *a Prioniodus elegans* PANDER, 1856, LO 3552 t, Stora Backor 12, lateral views, × 120. *b Oistodus* cf. *elongatus* n. sp., LO 3553 t, Latorp 2, × 60. *c Scandodus* n. sp., LO 3554 t, Latorp 2, lateral and superior views, × 60. *d Distacodus peracutus* n. sp., LO 3555 t, Tomten 4, × 60.

widened. Its point is inconspicuous. The oral edge is sharp and almost straight. It is rather long. It makes an angle of c 30° with the aboral margin. The latter, too, is little curved, except anteriorly, where it curves upward to meet the anterior edge at about 45°. On the inner side, there is a slight flexure of the margin just posterior to the upward curvature.

The cusp is rather strongly proclined. As a rule, it is almost twice as long as the base. It is slender and straight, except for some lateral flexure. Its inner face is strongly carinate, the outer face scarcely at all so. Its edges are sharp. The anterior edge is straight and may be deflected inwards (as in pl. 4, fig. 11). The posterior edge shows a slight sigmoidal curvature. It makes a sharp angle with the oral edge.

There may be a faint depression along the aboral margin. On the outer face there is a depression just behind the anterior corner.

Remarks. *Oistodus venustus* STAUFFER, 1935 a (p. 147, pl. 12 fig. 12) obviously lacks the lateral carina of my species (the cusp is 'flattened laterally'). RHODES (1935 b, p. 295 -296) adds that in *O venustus* the base should be about as long as the cusp.

Occurrence. The holotype is from the base of the U. Pl. Ls of Yxhult, section II, sample 7. The species occurs in the upper part of the L. Pl. Ls. and abounds in higher strata.

Material. 682 specimens.

### *Oistodus gracilis* n. sp.

Pl. 5, figs. 1, 2.

Derivatio nominis. *Gracilis*, Lat. = graceful.

Holotype, LO 3672 T, pl. 5, fig. 1.

Diagnosis. A small, slender *Oistodus* with very shallow basa cavity, recurved cusp, curved oral edge and broadly arched abora margin.

Description. The basal cavity is but a groove along the base The posterior extension of the base is rather thin. It is curved, and i rounded at the end. Its oral edge is rather long and sharp.

The cusp is more or less recurved, with sharp edges, the posterio of which makes a more or less sharp angle with the oral edge. Ther are faint lateral carinae.

Occurrence. The holotype is from the L. Pl. Ls. of Latorp sample 5. The species is very rare in the L. Pl. Ls.

Material. 11 specimens.

### *Oistodus inaequalis* PANDER, 1856.

Pl. 3, figs. 52—57.

1856. *Oistodus inaequalis* PANDER, p. 27, pl. 2, fig. 37.
1944. *Oistodus inaequalis* PANDER — BRANSON & MEHL, p. 240, pl. 93 fig. 44.

The basal cavity is very obtusely triangular in outline. It is th most shallow in the specimens from the L. Pl. Ls. About mid-length it flares rather widely to the inner side. The oral edge is sharp an slightly curved. In lateral view, the aboral margin is almost straight

The cusp is reclined and bent inwards at the base. It is rather long straight-edged and pointed. The edges are sharp. The posterior edg makes a sharp angle with the oral edge. The outer face is smoothl rounded. Along the inner face there runs a rather strong, rounde carina that begins where the base bulges out.

Occurrence. The species is rather common in the Ce. zone and the L. Pl. Ls. As for its alleged occurrence in the Esthonian Glaukonitsand (FAY 1952, p. 135) the same applies as to *O. lanceolatus*, q. v.

Material. 100 specimens.

### *Oistodus lanceolatus* PANDER, 1856.

Pl. 3, figs. 58—60.

1856. *Oistodus lanceolatus* PANDER, p. 27, pl. 2, figs. 17, 18 (not 19).
1944. *Oistodus lanceolatus* PANDER — BRANSON & MEHL, pp. 239—240, pl. 93, fig. 23.

The basal cavity in this species is rather deep posteriorly. Its point is situated rather far anteriorly, and anterior to that the cavity is very shallow. The cavity is more or less compressed laterally. The oral edge of the base is sharp and smoothly curved. The aboral margin makes a rather sharp angle with the oral edge, and from that corner forwards it is first slightly concave, then, beneath the point of the cavity, convex, then again concave. The antero-basal angle is sharp, but its point is rounded off.

The cusp is more or less strongly reclined. It is curved laterally. It is wide and thin. The lateral faces as a rule are smooth, but basally, the inner face may be rather sharply keeled. The edges are sharp and slightly curved. The posterior edge makes a very sharp angle with the oral edge.

There may be a thin, depressed rim along the aboral margin. The outer face of the tooth generally carries a distinct depression just where the cusp begins (compare *O. forceps*). There may be basal canalules.

Occurrence. The species is quite common in the U. Pl. Ls. and sparse in the Lb. Ls. FAY (1952, p. 135) states it to occur in 'Glaukonitsand, Baltic Provinces, Russ.'. In none of the works listed by him is the stratigraphic occurrence of the species mentioned, except by BRANSON & MEHL (1944, pp. 239—240) who merely mention it as Tremadocian. Neither BRANSON & MEHL nor FAY give any information as to how they arrived at their successively more precise stratigraphic assignments.

Material. 205 specimens.

### *Oistodus linguatus* n. sp.

Pl. 3, figs. 39—41.

Derivatio nominis. *Lingua*, Lat. = tongue, refers to the tongue-like posterior extension of the base.

Holotype. LO 3628 T, pl. 3, fig. 41.

Diagnosis. An *Oistodus* with arched base with the posterior extension tongue-like and the anterior corner bent down, and th straight, slender cusp reclined, carinate on the inner face.

Description. The basal cavity is a narrow slit that flares t the inner side beneath the cusp. The whole base is arched, with curved rather narrow, sharp-keeled posterior extension and slightly wide anterior part that is bent down. The antero-basal angle is acute.

The cusp is slightly reclined. It is straight, rather narrow and blade like. Its edges are sharp. The anterior edge basally is almost perpendicular, then curves posteriorly. The posterior edge is slightly curved It makes a sharp angle with the oral edge. The outer lateral face i smoothly rounded. The inner face carries a strong rounded carina tha begins where the base bulges out.

Remarks. The species reminds one of *O. inaequalis*. In tha species, the basal cavity is wider laterally, and the base never is arched

Occurrence. The holotype is from the L. Pl. Ls. of Stora Backo sample 8. The species is very rare in the Pl. Ls. and the Lb. Ls.

Material. 18 specimens.

### *Oistodus linguatus* n. sp. var. *complanatus* nov.

Pl. 3, figs. 37, 38.

Derivatio nominis. The variety, as it were, is laterall compressed.

Holotype. LO 3625 T, pl. 3, fig. 37.

Diagnosis. Like *Oistodus linguatus*, but the base does no flare laterally, and its anterior part does not project downwards.

Description. The basal cavity is slit-like. Anteriorly, it i rather deep. The posterior projection of the base is slightly arche narrow and sharply keeled. Posteriorly the aboral margin is horizonta then, beneath the cusp, it bends downward, then bends again to becom horizontal just back of the antero-basal angle. The latter is almost 90

The cusp is reclined, narrow and straight-edged. The anterior edg is perpendicular basally. The posterior edge makes a sharp angle wit the oral edge.

Occurrence. The holotype is from the boundary between th Pl. Ls. and the Lb. Ls. of Stora Backor, sample 18. The variety occu rarely above that boundary.

Material. 5 specimens.

### *Oistodus linguatus* n. sp. var. *extenuatus* nov.

Pl. 3, fig. 42.

Derivatio nominis. The anterior corner of the base extenuate.

Holotype. LO 3629 T, pl. 3, fig. 42.

Diagnosis. Like *Oistodus linguatus*, but the anterior part of the base is more drawn-out and projects farther downwards.

Description. The feature mentioned in the diagnosis being the one that distinguishes this variety from *O. linguatus*, nothing needs to be added to describe it.

Occurrence. The holotype is from the Lb. Ls. of Bjällum, sample 7. The variety is very rare in the Lb. Ls. and next below.

Material. 7 specimens.

### *Oistodus longiramis* n. sp.

Pl. 4, figs. 35—37.

Derivatio nominis. The name refers to the drawn-out basal projections or 'long branches'.

Holotype. LO 3664 T, pl. 4, fig. 36.

Diagnosis. An *Oistodus* with long, slender anterior and posterior basal projections, small basal cavity and long, slender, reclined cusp.

Description. The basal cavity is restricted to the part of the base from which the basal projections and the cusp take their origin. Along the projections it is inverted. Its inner lateral sheath flares more widely than the outer one. There is an anterior as well as a posterior basal projection. Together, they form a broad arch. Both of them are long and slender, the posterior one the longest. The oral edge is sharp and straight, except anteriorly, where it is convexly curved.

The cusp is straight-edged, reclined, long and blade-like. Its outer lateral carina is blunt and inconspicuous. The inner lateral carina is rather strong, especially at the base. The edges are sharp. The posterior edge makes a sharp angle with the oral edge.

There may be basal canalules.

Occurrence. The holotype is from the U. Pl. Ls. of Lanna, sample 6. The species is common in the basal part of the U. Pl. Ls.

Material. 70 specimens.

### *Oistodus parallelus* Pander, 1856.

Pl. 4, figs. 26—31, 43, textfig. 3 N, O.

1856. *Oistodus parallelus* Pander, p. 27, pl. 2, fig. 30.

Two trends have been found in this species. In one of them the basal cavity sends a shallow extension to the antero-basal angle and is not at all inverted (textfig. 3 N). Such specimens occur in the Ce. zone of Stora Backor. In the bulk of the younger specimens the part of the basal cavity anterior to its point is inverted (pl. 4, figs. 26, 30, textfig. 3 O). In other respects the two kinds are identical. With more material from the Ce. zone one might, perhaps, distinguish them as two species of stratigraphic value.

The oral edge is sharp, straight and not very long. It makes an angle of c 35° with the aboral margin. The latter is strongly bent a little anterior to its middle, so that its anterior and posterior parts run at right angles to each other. The antero-basal angle is about 90°. In this way, the base as a whole is roughly rectangular.

The cusp is so strongly reclined as to run parallel to the posterior part of the aboral margin (hence the name). It is big, sharp-edged and straight save for a slight lateral deflexion. Its faces are adorned with rather strong, rounded carinae, the inner of which begins as a swelling on the base.

No basal canalules have been observed.

Remarks. The specimens figured differ from Pander's drawing in having a marked antero-basal angle. The angle portion being thin, it is frequently broken off, and the similarity is then complete.

Occurrence. The species is very common in strata below the Lb. Ls.

Material. 526 specimens.

### *Oistodus selene* n. sp.

Pl. 4, figs. 19, 20.

Derivatio nominis. *Selene*, Greek = moon, refers to the shape of the base.

Holotype. LO 3652 T, pl. 4, fig. 20.

Diagnosis. A laterally compressed *Oistodus* with the base semicircular in outline and the cusp tangential at mid-width of the base.

Description. The basal cavity is rather deep and long, not very wide laterally, and sickle-shaped in outline. The aboral margin is almost straight, whereas both the oral edge and the basal part of the anterior edge are curved. Thus, the whole of the base is semicircular in outline.

The cusp is reclined. It is long, broad, thin and blade-like. Its edges are sharp and almost straight. The posterior edge makes a sharp angle with the oral edge. There is no lateral flexure.

Remarks. The species is very similar to *Oistodus abundans* Branson & Mehl, 1933 (p. 109, pl. 9, figs. 11, 17) from the Middle Ordovician Plattin formation of Missouri. It differs from that species in being strongly compressed laterally and in showing no lateral flexure.

Occurrence. The holotype is from the U. Pl. Ls. of Lanna, sample 10. The species is uncommon in the U. Pl. Ls. Two specimens were found in the L. Pl. Ls. of Lanna.

Material. 34 specimens.

### *Oistodus triangularis* n. sp.
Pl. 4, figs. 14—18.

1944. *Oistodus acuminatus* Pander — Branson & Mehl, p. 240, pl. 93, figs. 24, 25.

Derivatio nominis. The name refers to the triangular cross section.

Holotype. LO 3649 T, pl. 4, figs. 14—16.

Diagnosis. An *Oistodus* with one very prominent lateral costa.

Description. The basal cavity is rather deep and wide. The oral edge is flattened out into a high and thin keel. The aboral margin is almost straight in lateral view and but little concave at its middle.

There are three edges, viz. the sharp anterior and posterior edges and the lateral costa that is very prominent and reaches the aboral margin so that the base is extended at that side. All three edges are slightly curved in a posterior direction.

The cusp is but little recurved or erect. It is long and slender. Its posterior edge makes a sharp angle with the oral edge.

There is a slight depression along the aboral margin.

Remarks. This species is not similar to *Oistodus acuminatus*. In that species the cusp is reclined and slightly curved towards the anterior, and both lateral faces are costate (cf. Pander 1856, pl. 2, fig. 20).

Occurrence. The holotype is from the U. Pl. Ls. of Yxhult, section II, sample 7. The species is common in the U. Pl. Ls. Two specimens were found in the strata next above and two doubtful specimens next below.

Material. 160 specimens.

### *Oistodus* n. sp.
Pl. 3, fig. 26.

A small *Oistodus* with sharp and thin keels and high and thin lateral costae, one on each side.

Occurrence. The specimen figured is from the L. Pl. Ls. of Lanna, sample 1. Another specimen is from the same level at Ulunda, sample 1.

### *Oneotodus* n. gen.

Derivatio nominis. After the Oneota formation of Minnesota, whence the type species.

Type species. *Distacodus? simplex* Furnish, 1938, p. 328, pl. 42, figs. 24, 25, textfig. 1, O, p. 333.

Definition. Simple teeth with a well-defined basal cavity and he cusp un-keeled and subcircular in cross section.

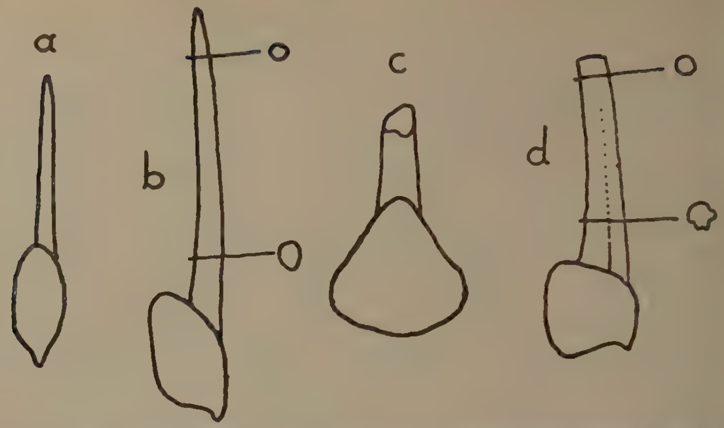


Fig. 6. Cross section and aboral outlines in *Oneotodus variabilis* n. sp. × 60. Same specimens as *a*, pl. 2, fig. 15, *b*, fig. 47 (holotype), *c*, fig. 17, *d*, fig. 18.

### *Oneotodus variabilis* n. sp.

Pl. 2, figs. 14—18, 47, pl. 5, figs. 4, 5, textfig. 6.

Derivatio nominis. The species is highly variable.

Holotype. LO 3598 T, pl. 2, fig. 47.

Diagnosis. A rather slender *Oneotodus* with the cusp slightl reclined and the basal cavity conical, wide and deep.

Description. In lateral view, the basal cavity is a straigh edged sub-equilateral triangle, the apex of which is close to the anteric margin. In cross section the base may be elliptical, subtrapezoidal c subtriangular. The two latter types can be derived from the simp elliptical type (textfig. 6), and intermediate forms exist.

The cusp is but little reclined. Although in a few specimens it lobate in cross section basally, it is always subcircular apically.

The surface of the tooth is ornamented lengthwise with fine, regul and densely spaced striae that are visible at c 250 × magnificatio The surface of some specimens, e. g. the holotype, is marked by seri of elongated shallow pits.

Remarks. With a bigger material one might, perhaps, distinguis more than one species in this assemblage. The simplest forms diff from *Oneotodus simplex* (Furnish) chiefly in having a more slende slightly reclined cusp.

Occurrence. The holotype is from the Ce. zone of Stora Backo sample 5. The species is rather common in the Ce. zone and is occasio ally found in higher strata.

Material. 40 specimens.

## *Paltodus* PANDER, 1856.

Type species. *Paltodus subaequalis* PANDER, 1856.

Pander's description (translated from PANDER 1856, p. 24). We carry to this genus all those teeth in which the front or the hind eel, maybe even both of them, is blunted off to be flat or rounded, nd in which the lateral faces are always unsymmetrical. They are ighly remarkable forms the like of which scarcely is to be found in ecent animals.'

Remarks. Pander's definitions of *Paltodus* and *Scolopodus* cover ach other in that both genera have rounded anterior and posterior nargins. Both costate and uncostate forms may be included in *Paltodus*, oth symmetrical and unsymmetrical forms in *Scolopodus*. Unsymnetrical costate forms may thus belong to either genus. Unfortunately, here is quite a number of such conodonts.

The rounding off of the anterior keel can often be interpreted as lateral flexure. In *Paltodus inconstans* one will thus find numerous pecimens with the anterior edge sharp, as well as such with rounded nterior margin and an antero-lateral costa, i. e. a deflexed anterior dge. There seems to be a trend to disregard the rounded edges as a haracter in this genus. Thus, for instance, BRANSON, MEHL & BRANSON 1951, p. 7) erect a species, *P. staufferi*, with a sharp anterior edge s well as a posterior keel. Further, no genus has been erected for imple, irregularly costate conodonts with sharp anterior and posterior dges, nor does this seem necessary at present.

For these reasons it seems best to drop the condition that either nargin should be rounded from the definition of *Paltodus*.

The one remaining of the characters mentioned by PANDER is the ack of symmetry. With this definition, *Acodus* will fall within *Paltodus*. f the genus *Acodus* be kept for unicostate unsymmetrical simple onodonts, *Paltodus* is left with the uncostate and the multicostate nes. For the former group, I propose a new genus, *Scandodus*.

Redefinition. To *Paltodus* belong simple, unsymmetrical, ulticostate conodonts.

## *Paltodus inconstans* n. sp.

Pl. 4, figs. 3—8.

Derivatio nominis. The name refers to the inconstancy of ne costae.

Holotype. LO 3645 T, pl. 4, figs. 7, 8.

Diagnosis. A rather robust *Paltodus* with little recurved cusp, ne flat inner face with one or no median costa, the rounded outer ce with up to four costae.

Description. The basal cavity is hemipyramidal. The ora edge is sharp and almost straight. The aboral margin is long and almos straight in lateral view. It makes an angle of about 60° with the ora edge and with the anterior edge an angle of about 45°. The anter basal angle may be rounded off. The base flares rather widely to th outer side.

The cusp is slightly recurved. It is rather long and somewhat robus Its outer face is rather strongly convex, the inner face flat or a litt concave. Its edges are sharp. The anterior edge may be flexed inward The flat inner face as a rule carries a sharp median costa. The out face may carry up to four costae anteriorly. As a rule there is but on or there may be none at all. The costae face posteriorly.

Occurrence. The holotype is from the L. Pl. Ls. of Yxhul section II, sample 4. The species is common in the L. Pl. Ls. and occasionally found in higher strata.

Material. 135 specimens.

### *Paracordylodus* n. gen.

Derivatio nominis. *Para*, Greek = wrong, a ’wrong *Cord lodus*’.

Type species. *Paracordylodus gracilis* n. sp.

Definition. Compound conodonts with a cusp, a posteri denticulate edge or process, no lateral processes, and an anterior unde ticulated process that is distinctly set-off.

### *Paracordylodus gracilis* n. sp.

Pl. 6, figs. 11, 12.

Derivatio nominis. *Gracilis*, Lat. = graceful.

Holotype. LO 3715 T, pl. 6, fig. 11.

Diagnosis. A laterally compressed *Paracordylodus* with recurv cusp, arched posterior process with long and sharp reclined denticle and the anterior process directed obliquely backwards.

Description. The basal cavity is very shallow and narro slightly deepened beneath the cusp.

The posterior process is broadly arched. The denticles are big a reclined, bigger and more strongly reclined the farther posterior They are laterally flattened, straight-edged and sharply pointed.

The cusp is smoothly recurved, with one thin costa on each si These costae do not get near the aboral margin. The anterior proce is rather big, straight and directed obliquely backwards, in continuati of the basal part of the cusp.

The whole unit may be slightly curved sideways.

Occurrence. The holotype is from the L. Pl. Ls. of Latorp, ample 5. The species is uncommon in the L. Pl. Ls.

Material. 29 specimens.

### *Pravognathus* Stauffer, 1936.

### *Pravognathus aengensis* n. sp.

Pl. 5, figs. 10—13.

Derivatio nominis. After the Änga quarry of Stora Backor ä transcribed ae).

Holotype. LO 3681 T, pl. 5, figs. 12, 13.

Diagnosis. A nearly straight *Pravognathus* with one main tooth and a small number of irregular denticles to one side of it, one or none o the other. Whole unit curved laterally.

Description. The basal cavity that is rather deep along the whole unit is the deepest and widest beneath the main denticle. In the holotype it is seen to send a conical extension even into the adjacent denticle. One of the lateral faces of the base is higher than the other and more or less curved inwards, so that the cavity opens in that direction.

The main denticle (I hesitate to call it cusp) is erect. It is not much higher and thicker than the other denticles. On the basal part anterior to it there is one or, as in the holotype, no denticle. The denticles posterior to the main denticle are rather big, of different sizes, and mostly reclined. All the denticles are slightly compressed laterally. They curve a little inwards.

Remarks. In assigning to *Pravognathus* a species that is not slightly S-shaped seen from above I have violated the definition of that genus. However, I believe that such a feature as slight curvatures are of little practical value in determining conodont genera. In being bar-like, irregular, with the main denticle or cusp not much bigger than the biggest of the other denticles and in a subterminal position, it agrees with *Pravognathus*.

Occurrence. The species is very rare in the Ce. zone of Stora Backor. The holotype is from sample 5.

Material. 3 specimens.

### *Prioniodina* Ulrich & Bassler, 1926.

Type species. *Prioniodina subcurvata* Ulrich & Bassler, 1926.

Remarks. Ulrich & Bassler define the genus *Prioniodina* thus 1926, p. 18), 'Base of tooth more or less curved, crowned with numerous, subparallel, rounded, discrete denticles all inclined in one direction, one of which located in the median third, is considerably larger than the others.' and their genus *Euprioniodina* (1926, p. 29) is 'Lik *Prioniodina* but main cusp much more produced and interior part bar, smaller, shorter, more sharply deflected' etc.

I do not think that either the size of the cusp or the relative lengt of the bars are sufficient criteria for distinguishing two genera.

### *Prioniodina? deflexa* n. sp.

Pl. 6, figs. 31—35.

Derivatio nominis. The anterior denticulate edge is d flected.

Holotype. LO 3731 T, pl. 6, figs. 34, 35.

Diagnosis. A *Prioniodina* with the short minutidenticula anterior edge deflexed laterally and the oral margin long, with b reclined, blade-like denticles.

Description. The basal cavity anteriorly is triangular in outlin with its apex but little projecting into the cusp. Posteriorly, it is b a shallow groove that may be inverted.

The anterior denticulate edge of the base is not prolonged into a ba It may carry about four minute denticles that are pressed close to t edge and do not stand apart. As a rule, it is deflexed laterally. T oral denticulate edge is rather long and may be slightly curved. T denticles are big, blade-like and reclined, biggest and most strong reclined posteriorly. The aboral edge describes a smooth, concave curv

The cusp is but little recurved, rather high and slender. It is su circular or lanceolate in cross section. Its outer face may occasional carry a costa.

Occurrence. The holotype is from the U. Pl. Ls. of Tomte sample 7. The species is rather common in the U. Pl. Ls.

Material. 68 specimens.

### *Prioniodina densa* n. sp.

Pl. 6, fig. 20.

Derivatio nominis. *Densa* refers to the densely crowd denticles.

Holotype. LO 3720 T, pl. 6, fig. 20.

Diagnosis. A *Prioniodina* with distinct processes, big cusp a narrow, closely crowded denticles, the cusp and all the denticles pr clined.

Description. The basal cavity is rectilinear in outline, sendi deep extensions into the bars. The bars are straight and meet at abo 60°.

Anteriorly, the denticles are closely appressed to that process. T denticles of the posterior process are rather high, narrow, and discre but apically. They are slightly proclined. On one side, the basal sheath carries an undulation that is reminiscent of a lateral process, but it is not costate.

The cusp is big and proclined. It is almost straight-edged and blade-like.

Occurrence. The holotype is from the Lb. Ls. of Bjällum, sample 6. The species is uncommon in the Lb. Ls.

Material. 11 specimens.

### *Prioniodina diprion* n. sp.
Pl. 5, fig. 43.

Derivatio nominis. *Prion*, Greek — saw, the species has two saws.

Holotype. LO 3703 T, pl. 5, fig. 43.

Diagnosis. A minutidenticulate *Prioniodina* with no free process, the denticulate edges long and meeting at sharp angles, the base bigger than the cusp.

Description. The basal sheath connecting the two edges on one side is more or less flat, on the other flares rather strongly. The denticulate edges meet at about 30°. The denticles are very small. The cusp forms a direct continuation of the base and is proclined.

Occurrence. The holotype is from the U. Pl. Ls. of Skultorp, sample 5. The species is very rare in the U. Pl. Ls. and the Lb. Ls.

Material. 5 specimens.

### *Prioniodina flabellum* n. sp.
Pl. 6, figs. 23—25.

Derivatio nominis. *Flabellum*, Lat. = fan.

Holotype. LO 3723 T, pl. 6, figs. 23, 24.

Diagnosis. A *Prioniodina* with but one slender denticle in front of the very big, blade-like, reclined cusp, and several flattened denticles behind.

Description. The basal cavity extends along the unit as a rather shallow groove that is somewhat deeper and wider beneath the cusp. The aboral margin is straight and horizontal posteriorly. Anteriorly, it bends downwards in a soft curve or rather abruptly.

The front denticle is slightly proclined, high and slender. It is free but at its apex. It may be deflected laterally. The posterior denticles are slightly reclined, rather high, thin and wide, and fused basally.

The cusp is slightly reclined, very big, high, wide and thin. Its edges are sharp and straight.

Occurrence. The holotype is from the Lb. Ls. of Stora Backor, sample 20. The species is rather common in the Lb. Ls.

Material. 33 specimens.

### *Prioniodina inflata* n. sp.
Pl. 6, figs. 26, 27.

Derivatio nominis. The name refers to the inflated base.

Holotype. LO 3726 T, pl. 6, fig. 27.

Diagnosis. A *Prioniodina* with no free process, very big, blade-like cusp, and unsymmetrical, inflated base.

Description. The basal cavity is wide and rather deep, extending all along the base. The sheath is very thin and connects the tips of the denticulate edges so that no process is left free. The base flares widely to one side.

The denticles are reclined, rather low and broad and strongly compressed laterally. Anteriorly, there are up to three of them, but as a rule there is but one. The oral denticles are more numerous. They are reclined.

The cusp is erect, with sharp, slightly curved edges and faintly keeled lateral faces. It is very thin, high and broad.

Occurrence. The holotype is from the U. Pl. Ls. of Lanna, sample 10. The species is uncommon in the U. Pl. Ls.

Material. 42 specimens.

### *Prioniodus* PANDER, 1856.

Type species. *Prioniodus elegans* PANDER, 1856.

Pander's description (translated from PANDER 1856, p 29). 'Under this denomination do we unite all those teeth or jaws in which a very big tooth arises, to one or both sides of which a row of smaller ones is added. The hollow base extends lengthwise beneath all these teeth and to a certain height.'

Remarks. Pander's definition was based on a fragmentary material. Several specimens identical with Pander's fig. 22, pl. 2 showing the type species, *Prioniodus elegans*, were available to me. In some of them, not only the anterior and posterior processes were left but also a lateral process. Further, fragmentary specimens of *Prioniodus evae* may be almost identical with Pander's figure. It was therefore to be suspected that Pander's figure was incomplete. Later on, it appeared that ÖPIK had figured a complete specimen of *Prioniodus elegans* in 1936 (fig. 57). His little paper is written in Esthonian, but in a short summary he states that 'It appears as quadraxial, with a central cusp and three denticulate wings divergent at unequal angles. The nomen clature of other species of *Crioniodus*, based on the picture and description of the incomplete specimen of PANDER, must be revised.'

Redefinition. To the genus *Prioniodus* belong compound conodonts with a subcentral cusp, from the base of which diverge three denticulate edges or processes, one posteriorly, one anteriorly and one laterally.

A few such species have previously been brought to *Dichognathus* BRANSON & MEHL, 1933.

*Prioniodus elegans* PANDER, 1856.
Pl. 5, figs. 26—29, textfig. 5 a.

1856. *Prioniodus elegans* PANDER, p. 29, pl. 2, figs. 22, 23.
1936. *Prioniodus elegans* PANDER — ÖPIK, pp. 106, 107, fig. 57.

This is a rather robust *Prioniodus* with big, sharp, blade-like cusp and rather short, stout denticles.

The basal cavity is rather shallow and narrow, extending along the processes. The posterior process as a rule is broken off. It is straight with the rather low and stout denticles in one plane. The denticles are free at their apices. Along the aboral margin there runs on each side a wide, shallow depression.

The anterior and lateral processes are both directed rather steeply downwards. They make an angle of around 90° with one another. Both of them carry low, rounded, slightly flattened denticles. The lateral process begins as a sharply offset median costa that runs all along the cusp.

The cusp is suberect, big and blade-like. Its edges are slightly curved and very sharp. The outer face is smooth, the inner provided with the single costa that gives rise to the lateral process.

Occurrence. The mostly fragmentary specimens are rather scarce in the U. Pl. Ls. One specimen was found in the L. Pl. Ls. of Stora Backor.

Material. 20 specimens.

*Prioniodus evae* n. sp.
Pl. 6, figs. 4—10.

Derivatio nominis. After a cousin of mine.

Holotype. LO 3713 T, pl. 6, fig. 7.

Diagnosis. A rather slender *Prioniodus* with the posterior process twisted, the anterior and lateral processes rather big and subequal, denticles blade-like and cusp big, with one median carina on each side.

Description. The basal cavity is a very shallow groove, but little deepened beneath the cusp.

The posterior process is slightly curved inwards. It is strongly twisted so that whereas the anterior denticles are perpendicular, the posterio denticles point almost horizontally outwards. Also, the denticles ar more and more reclined posteriorly. They are big, biggest a shor distance from the cusp, sharp-edged and flattened. Basally, they ar fused. Parallel to the aboral margin and half-way up the fused base of the denticles there runs on each side a carina. These carinae tur round and run down the sides of the anterior and lateral processes Both of these, again, carry another carina on the other side, and th last-mentioned carinae sometimes meet. The carina on the inner sid of the posterior process is by far the strongest. The others are blun and low.

The anterior and lateral processes are both directed steeply downwards, continuing in lateral view the axis of the cusp. They mak with one another an angle of little more than 60°. They are slightl bent backwards. Their denticles are smaller than those of the posterio process. The lateral process arises on the inner side at the basal en of a median longitudinal costa of the cusp.

The cusp is somewhat reclined. It is big, flattened, sharp-edged an blade-like. It carries a median longitudinal costa on each side.

Occurrence. The holotype is from the U. Pl. Ls. of Yxhult section II, sample 7. The species is abundant in the basal strata of th U. Pl. Ls., rare in higher strata.

Material. 367 specimens.

### *Prioniodus navis* n. sp.

Pl. 5, figs. 31—35.

?1913. *Prioniodus alatus* HADDING, pl. 1, fig. 10.

Derivatio nominis. *Navis*, Lat. = ship, the posterior process with the cusp is reminiscent of a ship's bow.

Holotype. LO 3696 T, pl. 5, fig. 33.

Diagnosis. A multidenticulate *Prioniodus* with slender cusp long, recurved anterior process, and the lateral process at right angle with the posterior process.

Description. The basal cavity is deep and extends all along the processes. It projects into the cusp.

The posterior process is rather long and straight. The anterior process is recurved so as to make an angle of less than 90° with the posterior process, and bent away from the lateral process. The latter i straight and makes a right angle with the process, or nearly so. Th angle between the anterior and lateral processes is about 30°. The basa sheath is smooth between the anterior and posterior processes, folde inward between the anterior and lateral processes; and undulated between the lateral and posterior processes.

The cusp is rather slender and erect, provided with three thin ridges, one for each process. The denticles are rather small and erect. They are numerous or, occasionally, almost absent on any of the processes.

Remarks. The cotypes of HADDING's *Prioniodus alatus* (1913, pl. 1, figs. 9, 10) belong to different species. Fig. 9 (specimen LO 2348 T) may represent a *Prioniodus* that has, however, lost both the cusp and the anterior (or the lateral) process. Still, it is the best specimen of the two, and I choose to regard it as the holotype of *Prioniodus? alatus* HADDING, 1913. The specimen (LO 2349 t) represented by Hadding's pl. 1, fig. 10 is a true *Prioniodus* that has lost its anterior process. It may possibly belong to *P. navis*.

Occurrence. The holotype is from the Lb. Ls. of Stora Backor, sample 20. The species is rather common in the Lb. Ls.

Material. 40 specimens.[1])

### *Prioniodus acodiformis* n. sp.
Pl. 5, fig. 42.

Derivatio nominis. The species resembles an *Acodus*.

Holotype. LO 3702 T, pl. 5, fig. 42.

Diagnosis. A *Prioniodus* with no free processes, a small base with mostly few denticles, and a big cusp.

Description. A thin basal sheath connects the three more or less widely divergent, rather short denticulate edges. The sheath tends to bulge inwards, toward the cavity. Especially in the smaller specimens there may be very few denticles or none at all on any of the edges.

The cusp is much higher than the base, strong and erect, and with one ridge to each of the denticulate edges.

Occurrence. The holotype is from the base of the U. Pl. Ls. of Tomten, sample 6. The species is very rare in the U. Pl. Ls.

Material. 8 specimens.

### *Prioniodus triangularis* n. sp.
Pl. 5, figs. 45, 46.

Derivatio nominis. The cross section of the base is triangular.

Holotype. LO 3706 T, pl. 5, fig. 46.

Diagnosis. A *Prioniodus* with no free processes, high, narrow base, passing gradually into the cusp, and minute denticles.

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[1]) In a forthcoming revision of HADDING's conodonts I have to change my mind on this matter.

Description. The basal sheath is almost level with the denticulate edges. The latter diverge but little, are thin, and have few and low denticles. The cusp is proclined, slightly curved and not very strong.

Remarks. The species ir related to *P. navis*, but the denticulate edges as a rule are much less divergent than in that species.

Occurrence. The holotype is from the Lb. Ls. of Bjällum, sample 6. The species is rare in the uppermost strata of the U. Pl. Ls. and in the Lb. Ls.

Material. 13 specimens.

### *Scandodus* n. gen.

Derivatio nominis. After Scandinavia.

Type species. *Scandodus furnishi* n. sp.

Definition. Simple, unsymmetrical conodonts with anterior and posterior keels but no costae. The lack of symmetry chiefly consists in that the cusp is twisted relative to the base so that the latter opens to one side of the cusp. There may be a broadly rounded median carina on one side, preferably the one towards which the basal cavity opens.

### *Scandodus furnishi* n. sp.

Pl. 5, fig. 3.

Derivatio nominis. In honour of the author of 'Conodonts of the Prairie du Chien beds'.

Holotype. LO 3674 T, pl. 5, fig. 3.

Diagnosis. A *Scandodus* with erect, blade-like cusp and shallow basal cavity.

Description. The basal cavity is rather shallow. Its apex points forward. It is rather widely flaring and opens inwards. Its aboral outline is roughly trapezoidal. The oral edge is sharp and severs the outer side of the base from the inner side.

The cusp is erect and blade-like. Its growth axis is straight, white and rod-like. Its lateral faces are little rounded, the outer face the least so. The edges are sharp and straight. The posterior edge runs at about right angles to the oral edge. The anterior edge is bent forward at the antero-basal angle.

In the holotype, there are two very faint little costae just above the base.

Occurrence. The holotype is from the L. Pl. Ls. of Skultorp, sample 1. The species is sparse in the Pl. Ls. Two doubtful specimens were found in the Ce. zone.

Material. 26 specimens.

### *Scandodus pipa* n. sp.

Pl. 4, figs. 38—42, textfig. 3 P.

Derivatio nominis. The name can be regarded as a conditional composition of letters. Actually, it is the Swedish *pipa* = smoking-pipe.

Holotype. LO 3669 T, pl. 4, figs. 41, 42.

Diagnosis. A *Scandodus* with the base roughly rectangular and laterally expanded posteriorly, the cusp reclined, long and strong, with a rounded median carina on the inner side.

Description. The basal cavity is rather deep and rounded in outline. Anterior to its point, it sends a shallow and rather wide extension to the anterior corner. The base is strongly expanded posteriorly, narrowing anteriorly. Orally, it is flattened, so that there is no oral margin. The oral surface makes an angle of somewhat less than 90° with the aboral margin. The latter makes a sharp bend about midwidth and then runs upwards and anteriorly. The bend may be drawn-out into something like a tongue (pl. 4, fig. 40) and this tongue is depressed.

The cusp is strongly recurved basally, then almost straight, reclined. It is long and rather strong. Its inner face that carries a rounded median carina is half turned towards the base. The outer face is smooth. The edges are sharp and rather keel-like. The posterior edge begins on the outer side of the oral surface.

In a few specimens there are basal canalules.

Remarks. This species is very similar to *Drepanodus? gracilis* (Branson & Mehl, 1933, p. 60, pl. 5, fig. 20). It differs from that species in being highly unsymmetrical and in carrying a stronger cusp. A few specimens from the Ce. zone are somewhat more symmetrical and thus more similar to *Drepanodus? gracilis*.

Occurrence. The holotype is from the U. Pl. Ls. of Bjällum, sample 2. The species is common in the Ce. zone and the L. Pl. Ls., growing more scarce in higher strata.

Material. 313 specimens.

### *Scandodus rectus* n. sp.

Pl. 4, figs. 21—25, textfig. 3 K.

Derivatio nominis. The species is nearly straight.

Holotype. LO 3654 T, pl. 4, figs. 22, 23.

Diagnosis. A long, slender, suberect *Scandodus* with deep, conical basal cavity and the outer face smooth, the inner face with a broad, rounded median carina.

Description. The basal cavity is deep and conical, with its apex anteriorly. The oral margin is rounded, with the beginning of the posterior edge to the outer side. It makes an angle of about 70° with the aboral margin that almost immediately curves to assume a less steep anterior direction. The aboral margin runs almost at right angles to the anterior margin.

The cusp is slightly recurved, reclined, erect, or even a little proclined. It is long and slender, almost as wide as the base. Its edges are sharp. Its outer face is smooth. On the inner face, there runs a rather wide sulcus along each of the edges, leaving a strong, rounded carina between them.

There may be basal canalules. Also, there may occasionally be a thin band of basal cavity inverted.

Remarks. There are a very few specimens that form a complete chain between this species and *Acontiodus rectus sulcatus*. They were found in the Lb. Ls. of Tomten, sample 9.

Occurrence. The holotype is from the Lb. Ls. of Bjällum sample 6. The species is rather common in the U. Pl. Ls. and the Lb. Ls.

Material. 165 specimens.

### *Scandodus* n. sp.

Textfig. 5 c.

This is a robust *Scandodus* with somewhat proclined cusp. The outline of the basal cavity is an equilateral triangle. The base flares ver widely to the inner side. The outer side is smooth. The edges of the cusp are rather sharp. Along each of them there runs on the inner side a rather deep and wide sulcus.

Occurrence. Two specimens were found in the L. Pl. Ls. o Latorp, one in sample 1, the other that is figured, in sample 2.

### *Scolopodus* Pander, 1856.

Type species. *Scolopodus sublaevis* Pander, 1856.

Pander's description (translated from Pander 1856, p 25). 'Slender, differently shaped teeth with the front and hind margin rounded off and the convex surfaces more or less ribbed. They ar distinguished at first sight from the genera described above by thei harder substance, white colour and lack of keels.'

Remarks. In order to be useful, the genus must have easil distinguished objective characters that separate it from other genera without restricting its sense too much. It is obvious that the whit colour is no good generic character, neither is the hardness. As fo rounded margins and numerous costae, both of these characters ar found in *Paltodus*. I therefore suggest the following new definition tha its to the type species, according to Pander's illustration (1856, pl. 2, ig. 3).

Redefinition. To *Scolopodus* belong multicostate, symmetrical, imple conodonts with or without posterior and anterior keels.

### *Scolopodus? peselephantis* n. sp.

Pl. 2, figs. 19, 20, textfig. 3 Q.

Derivatio nominis. *Pes*, Lat. = foot, *elephantis* = gen. of *elephans*, elephant foot.

Holotype. LO 3573 T, pl. 2, fig. 20.

Diagnosis. A very small, straight, pin-shaped *Scolopodus* with small base and shallow basal cavity.

Description. The basal cavity is very shallow, quite symmetrical with its apex centrally. The basal outline may be circular or a bit irregular. The base as a whole being shaped somewhat like the foot of an elephant, there is no true oral margin.

The cusp is rather strongly proclined, straight and but little tapering to a blunt apex. The cross section is sub-circular or more or less irregular. The surface is rather coarsely striated.

Occurrence. The holotype is from the basal strata of the L. Pl. Ls. of Latorp, sample 2. The species is very rare in Ce. and L. Pl. strata.

Material. 14 specimens.

### *Scolopodus rex* n. sp.

Pl. 3, fig. 32.

Derivatio nominis. *Rex*, Lat. = king.

Holotype. LO 3622 T, pl. 3, fig. 32.

Diagnosis. A slender, big, broadly curved *Scolopodus* with deep basal cavity, rounded cross section and numerous sharp, low costae.

Description. The basal cavity is deep, not very wide and sharply conical, its apex near the anterior surface. The growth axis as a rule is conspicuous and fairly straight.

The cross section is subcircular from the aboral margin to the apex of the cusp, so that anterior, posterior and oral margins do not exist. Except for the broad basal curvature the cusp is nearly straight and erect. It widens slowly at the base, but at the aboral margin there is a slight constriction. Except for the anterior surface that is generally smooth, the tooth is adorned with low, sharp, posteriorly facing costae that very nearly reach the aboral margin.

There may be basal canalules.

Remarks. The species is distinguished from *Scolopodus striatus* Pander, 1856, p. 26, pl. 2, fig. 8 by its slenderness and its sharp costae that very nearly reach the aboral margin.

Occurrence. The holotype is from the Lb. Ls. of Tomten, sampl 9. The species is rather uncommon in the U. Pl. Ls. and above.

Material. 49 specimens.

### *Scolopodus rex* n. sp. var. *paltodiformis* nov.

Pl. 3, figs. 33, 34.

Derivatio nominis. The variety is very *Paltodus*-like.

Holotype. LO 3623 T, pl. 3, figs. 33, 34.

Diagnosis. Like *Scolopodus rex*, but with more or less flattened twisted cusp with but faint striae on the outer side.

Description. Except for the features mentioned in the diagnosi the variety is indistinguishable from *Scolopodus rex*.

Remarks. Strictly speaking, this is a *Paltodus*. It is not only however, very similar to *Scolopodus rex*, but also there are intermediates so it can at best be distinguished as a variety.

Occurrence. The holotype is from the Lb. Ls. of Tomte sample 9. The variety is very rare in the U. Pl. Ls. and above.

Material. 10 specimens.

### *Scolopodus* n. sp.

Pl. 3, figs. 24, 25.

A small *Scolopodus* with five high, thin, symmetrically arrange costae, two anterior, laterally directed, two lateral, postero-laterall directed, and one posterior. In another specimen the posterior cost is missing.

Occurrence. The specimen figured is from the L. Pl. Ls. o Lanna, sample 1. The other specimen is from the same horizon at Stor Backor, sample 8.

### *Tetraprioniodus* n. gen.

Derivatio nominis. From *tettares*, Greek = four, the genu contains *Prioniodi* with four processes instead of three.

Type species. *Tetraprioniodus robustus* n. sp.

Definition. Compound conodonts with a cusp and four denticulate edges or processes, viz. one anterior, two lateral, one on eac side, and one posterior. At least the anterior edge may occasionall be undenticulated.

### *Tetraprioniodus denticulatus* n. sp.

Pl. 5, fig. 44.

Derivatio nominis. *Denticulatus*, Lat. = provided wit small teeth.

Holotype. LO 3704 T, pl. 5, fig. 44.

Diagnosis. A *Tetraprioniodus* with all or either of the four edges minutely denticulate and none of them forming a free process.

Description. The basal cavity projects into the cusp. The base is bigger than the cusp, long and pyramidal, laterally compressed, and diamond-shaped in cross section.

The cusp is proclined but may be curved so as to be nearly erect apically. The denticles are very small and may partly be absent.

Remarks. The species is slightly smaller, more symmetrical, less compressed laterally and more regularly denticulate than may be *Distacodus stola.*

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, sample 6. The species is very rare in the U. Pl. Ls.

Material. 5 specimens.

### *Tetraprioniodus robustus* n. sp.

Pl. 6, figs. 13—15.

Derivatio nominis. The species is thought to be rather robust.

Holotype. LO 3717 T, pl. 6, figs. 13—15.

Diagnosis. A *Tetraprioniodus* with three free processes, the posterior one long, multidenticulate, the two lateral ones shorter.

Description. The base is a narrow groove, extending all along the processes. The posterior process is long, straight, with numerous high, erect, narrow, apically free denticles. The two lateral processes are bent downwards and backwards. One of them may be farther posteriorly than the other. They are rather short and carry a few small, erect denticles. Anteriorly, there is hardly any free process. Seemingly, there may be denticles.

The cusp is very long, a bit recurved, little flattened, with one costa on each side.

Remarks. Only one specimen, the holotype, was found, in the L. Pl. Ls. of Latorp, sample 3. It appears rash to found a species on one specimen only, however, the specimen is complete with a very characteristic plan that has not, to my knowledge, been found before.

### *Trapezognathus* n. gen.

Derivatio nominis. The type species is trapezoidal in cross section.

Type species. *Trapezognathus quadrangulum* n. sp.

Definition. Compound conodonts with a cusp and four denticulate edges or processes, two of which are anterior and two posterior.

### *Trapezognathus quadrangulum* n. sp.

Pl. 5, figs. 38—41.

Derivatio nominis. The cross section is quadrangular.

Holotype. LO 3700 T, pl. 5, figs. 38, 39.

Diagnosis. A *Trapezognathus* with no free processes, rathe slender proclined cusp and smaller distance between the posterio denticulate edges than between the anterior.

Description. The thin basal sheath caves inwards posteriorl and laterally but is level with the denticulate edges anteriorly. Th cusp is proclined, quadrangular in section and about as long as th base. Anteriorly, the denticles are directed apically and laterally posteriorly they are directed orally and apically. Either set may b missing.

Occurrence. The holotype is from the Lb. Ls. of Stora Backor sample 19. The species is rare in the upper part of the U. Pl. Ls. an the Lb. Ls.

Material. 12 specimens.

### *Trichonodella* BRANSON & MEHL, 1948.

1933. *Trichognathus* BRANSON & MEHL, p. 36 (*non* BERTHOD).
1947. *Trichonodella* BRANSON & BRANSON, p. 551 (*nomen nudum*).
1948. *Trichonodella* BRANSON & MEHL, p. 527.
1953. *Trichonodella* BRANSON & BRANSON, 1947 — RHODES, p. 312

Type species. *Trichognathus prima* BRANSON & MEHL, 1933

Remarks. The status of this genus has become rather puzzling The name *Trichonodella* was used by BRANSON & BRANSON befor BRANSON & MEHL put it instead of the preoccupied generic nam *Trichognathus*. At that first use of the name *Trichonodella* no explanation was given that it was to substitute *Trichognathus*, nor was an diagnosis or type species of the genus given. RHODES states that '*Trichonodella* BRANSON & BRANSON has priority over *Trichonodella* BRANSON & MEHL, and the type species must be chosen from the two genosyntypes, *T. brassfieldensis* BRANSON & BRANSON and *T. carinat* BRANSON & BRANSON'. He choses *T. brassfieldensis*. Now, *Trichonodella* BRANSON & BRANSON is no longer identical with *Trichognathu* BRANSON & MEHL, nor with *Trichonodella* BRANSON & MEHL tha has *Trichognathus prima* for type species. Nevertheless, RHODES quote Branson & Mehl's original description of *Trichognathus* as referrin to *Trichonodella* BRANSON & BRANSON. In other words, the latte genus has no definition of its own, and is thus invalid (Internat. Rule Zool. Nomenclature, Art. 25, c). The one valid name *Trichonodell* applies to BRANSON & MEHL's genus that has *Trichognathus prima* for type species.

One might discuss whether species with the posterior process denticulated should really be brought to *Trichonodella.* I do not think so, but hesitate as yet to split the genus.

### *Trichonodella alae* n. sp.
Pl. 6, figs. 38—40.

Derivatio nominis. *Alae,* Lat. = wings, refers to the big anterior lateral processes.

Holotype. LO 3734 T, pl. 6, figs. 38, 40.

Diagnosis. A *Trichonodella* with very small cusp and posterior process and wide, long, slightly arched anterior lateral denticulate processes.

Description. The basal cavity is but a groove along the processes. The posterior process is very small. In most specimens it appears to be broken, as in the holotype. Possibly it is undenticulated. In any case, it carries no denticles on the level of the lateral processes.

The anterior lateral processes are subequal in size, both of them relatively very big. They are directed downwards and a little curved backwards. They make an angle of less than 90° with one another. They carry antero-posteriorly flattened, basally fused denticles that are rather uneven in size, biggest towards the cusp.

The cusp is small and laterally flattened.

Occurrence. The holotype is from the upper part of the U. Pl. Ls. of Bjällum, sample 5. The four other specimens found are from the Lb. Ls. of Stora Backor, sample 19.

### *Trichonodella flabellum* n. sp.
Pl. 6, figs. 28—30.

Derivatio nominis. *Flabellum,* Lat. = fan.

Holotype. LO 3728 T, pl. 6, fig. 30.

Diagnosis. A *Trichonodella* with equally big anterior lateral processes and rather big posterior process with strong blade-like denticles bigger and more reclined the farther posteriorly.

Description. The basal cavity is narrow, rather deep, and thin-sheathed. It grows shallower towards the extremities of the processes. The aboral margins are strongly and evenly concave.

The posterior process is rather long and slightly arched. It is multidenticulate, with small and erect denticles anteriorly, very big and strongly reclined denticles posteriorly. The denticles are flat, sharp-edged and pointed. They are fused basally. The anterior lateral processes run at approximately right angles to each other. Together with the sheath connecting them they are curved backwards. They carry few rather small, flattened, basally fused denticles that diverge laterally

The cusp is subtriangular in cross section and rather strong. It i suberect or slightly recurved.

Remarks. The species is closely similar to *Loxognathus flabellat* Graves & Ellison from which it differs in having equally big antero-lateral processes. *Loxognathus flabellata* occurs in the Fort Peña formation of Texas.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten sample 8. The species occurs sparsely in the U. Pl. Ls. and just above

Material. 46 specimens.

### *Trichonodella irregularis* n. sp.

Pl. 6, figs. 21, 22.

Derivatio nominis. The species is regarded as irregular

Holotype. LO 3722 T, pl. 6, fig. 22.

Diagnosis. A slender *Trichonodella* with the plane of the multidenticulate lateral processes cutting that of the flattened cusp an the inconspicuous posterior process at a very low angle.

Description. The basal cavity is but a groove extending alon the processes. It is but little deepened beneath the cusp. The posterio process is merely hinted at. It carries no denticles. The cusp is rathe long, flattened and sharp-edged.

The two antero-lateral processes are in one plane that intersect that of the cusp and the posterior process at a very low angle. On of them continues the axis of the cusp downwards, the other is horizontal. The processes carry numerous rather high, basally fused, sharp flattened denticles.

Occurrence. The holotype is from the Lb. Ls. of Stora Backo sample 19. The other two specimens were found at the same level.

### *Trichonodella longa* n. sp.

Pl. 6, figs. 47, 48.

Derivatio nominis. *Longus*, Lat. = long.

Holotype. LO 3739 T, pl. 6, figs. 47, 48.

Diagnosis. A *Trichonodella* with big, proclined cusp, no fre processes and the three denticulate edges very little divergent.

Description. The basal cavity is very deep and hemipyramidal. The basal sheath completely connects the three denticula edges. The posterior edge carries two or three coarse denticles. The tw anterior lateral edges do not diverge considerably either betwee themselves or from the posterior edge. As a rule, they carry minu denticles.

The cusp is proclined, roughly triangular in section, and rather long and thick.

Occurrence. The holotype is from the U. Pl. Ls. of Tomten, sample 6. The species is very rare in the U. Pl. Ls.

Material. 4 specimens.

### *Trichonodella longa* n. sp. var. *minor* nov.

Pl. 6, figs. 16—19.

Derivatio nominis. The variety is regarded as smaller than *T. longa.*

Holotype. LO 3719 T, pl. 6, figs. 18, 19.

Diagnosis. Like *Trichonodella longa,* but the three edges are more divergent, the cusp smaller and more proclined, and the denticulation somewhat sporadical.

Description. Nothing to be added to the diagnosis.

Occurrence. The holotype is from the Lb. Ls. of Bjällum, sample 6. The variety is rare in the Lb. Ls.

Material. 8 specimens.

### N. gen. n. sp.

Pl. 6, figs. 43, 44.

Description. A seemingly Trucherognathoid conodont with deep, thin-sheathed basal cavity and a single longitudinal row of denticles, one of which is not quite so small as the others. It occupies a submedian position and is curved to the inner side. The whole unit is somewhat arched as well as curved laterally, being strongly convex on the inner side, slightly concave on the outer side. The whole looks rather like a diadem. One specimen was found.

Occurrence. U. Pl. Ls. of Yxhult, section II, sample 7.

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## Explanation of Plate II

All figures × 30.

**Figs. 1—4.** *Acontiodus arcuatus* n. sp., p. 547. **Fig. 1,** LO 3556 t, Yxhult II 7. **Fig. 2,** LO 3557 t, Yxhult II 7. **Fig. 3,** LO 3558 t, Yxhult II 7. **Fig. 4,** LO 3559 T, *holotype*, Yxhult II 7.

**Figs. 5, 6.** *Acontiodus reclinatus* n. sp., p. 548. **Fig. 5,** LO 3560 t, Yxhult II 7. **Fig. 6,** LO 3561 T, *holotype*, Yxhult II 7.

**Figs. 7—11.** *Acontiodus rectus* n. sp., p. 549. **Fig. 7,** LO 3562 T, *holotype*, Lanna 12, posterio view. **Fig. 8,** same, lateral view. **Fig. 9,** LO 3563 t, Lanna 12. **Fig. 10,** LO 3564 t, Bjällun 6. **Fig. 11,** LO 3565 t, Bjällum 6.

**Figs. 12, 13.** *Acontiodus rectus sulcatus* n. var., p. 550. **Fig. 12,** LO 3566 T, Yxhult II 7 **Fig. 13,** same, opposite side. *Holotype.*

**Figs. 14—18.** *Oneotodus variabilis* n. sp., p. 582. **Fig. 14,** LO 3567 t. **Fig. 15,** LO 3568 t. **Fig 16,** LO 3569 t. **Fig. 17,** LO 3570 t. **Fig. 18,** LO 3571 t. All from Stora Backor 5.

**Figs. 19, 20.** *Scolopodus? peselephantis* n. sp., p. 595. **Fig. 19,** LO 3572 t, Latorp 2. **Fig. 20** LO 3573 T, *holotype*, Latorp 2.

**Figs. 21, 22.** *Drepanodus suberectus* (Branson & Mehl, 1933), p. 568. **Fig. 21,** LO 3574 t **Fig. 22,** LO 3575 t. Both from Stora Backor 20.

**Figs. 23, 24.** *Drepanodus homocurvatus* n. nom., p. 563. **Fig. 23,** LO 3576 t, Tomten 9. **Fig 24,** LO 3577 t, Bjällum 6.

**Figs. 25, 26.** *Drepanodus amoenus* n. sp., p. 558. **Fig. 25,** LO 3578 t, Stora Backor 5. **Fig. 26** LO 3579 T, *holotype*, Stora Backor 5.

**Figs. 27—29.** *Acodus gratus* n. sp., p. 545. **Fig. 27,** LO 3580 T, *holotype*. Yxhult II 7. **Fig. 28** LO 3581 t, Yxhult II 7. **Fig. 29,** same, front view.

**Figs. 30—33.** *Drepanodus arcuatus* Pander, 1856; p. 558. **Fig. 30,** LO 3582 t, Lanna 10. **Fig 31,** same, other side. **Fig. 32,** LO 3583 t, Latorp 5. **Fig. 33,** LO 3584 t, Skultorp 4.

**Fig. 34.** *Drepanodus conulatus* n. sp., p. 561. LO 3585 t, Yxhult II 3. Basal canalules an growth axis.

**Figs. 35—37.** *Drepanodus planus* n. sp., p. 565. **Fig. 35,** LO 3586 t, Yxhult II 7. **Fig. 36** LO 3587 t, Yxhult II 7. **Fig. 37,** LO 3588 T, *holotype*, Lanna 10.

**Fig. 38.** *Acodus pulcher* n. sp., p. 546. LO 3589 T, *holotype*, Stora Backor 5.

**Fig. 39.** *Drepanodus homocurvatus* n. nom., p. 563. LO 3590 t, Ulunda 7.

**Fig. 40.** *Drepanodus sculponea* n. sp., p. 567. LO 3591 T, *holotype*, Latorp 5. Phosphatic basa filling.

**Fig. 41.** *Drepanodus* cf. *subarcuatus* Furnish, 1938; p. 568. LO 3592 t, Stora Backor 5.

**Figs. 42, 43.** *Drepanodus deltifer* n. sp., p. 562. **Fig. 42,** LO 3593 t, Stora Backor 5. **Fig. 43** LO 3594 T, *holotype*, Stora Backor 5.

**Fig. 44.** *Drepanodus* cf. *subarcuatus* Furnish, 1938; p. 568. LO 3595 t, Stora Backor 5.

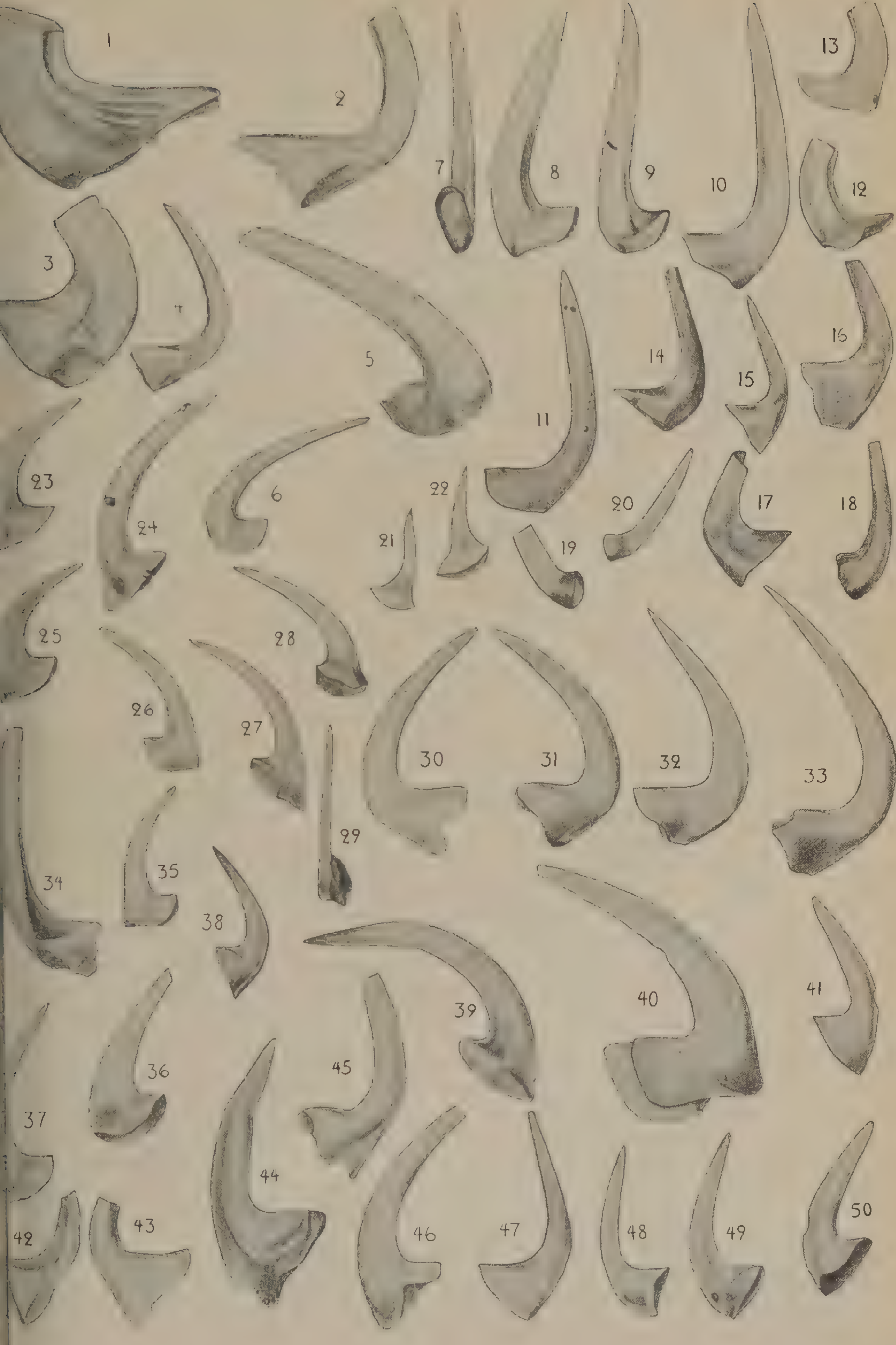
**Figs. 45, 46.** *Drepanodus* cf. *arcuatus* Pander, 1856; p. 560. **Fig. 45,** LO 3596 t, Ulunda 2 **Fig. 46,** LO 3597 t, Lanna 3.

**Fig. 47.** *Oneotodus variabilis* n. sp., p. 582. LO 3598 T, *holotype*, Stora Backor 5.

**Figs. 48, 49.** *Drepanodus numarcuatus* n. sp., p. 564. **Fig. 48,** LO 3599 t, Stora Backor 5 **Fig. 49,** LO 3600 T, *holotype*, Stora Backor 5.

**Fig. 50.** *Drepanodus* cf. *subarcuatus* Furnish, 1938; p. 568. Same specimen as fig. 41 seer from other side.

PL. II.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## Explanation of Plate III

All figures × 30.

**Figs. 1, 2.** *Distacodus peracutus* n. sp., p. 555. **Fig. 1.** LO 3601 T, *holotype*, Stora Backor 5. **Fig. 2,** same, posterior view.

**Figs. 3—9.** *Oistodus delta* n. sp., p. 573. **Fig. 3,** LO 3602 t, Tomten 6, side view. **Fig. 4.** same, posterior view. **Fig. 5,** LO 3603 T, *holotype*, Yxhult II 7, side view. **Fig. 6,** same, front view. **Fig. 7,** same, posterior view. **Fig. 8,** LO 3604 t, Tomten 6, superior view. **Fig. 9,** same, posterior view.

**Figs. 10—12.** *Acodus gladiatus* n. sp., p. 544. **Fig. 10,** LO 3605 T, *holotype*, Yxhult II 7. **Fig. 11.** same, other side. **Fig. 12,** LO 3606 t, Yxhult II 7.

**Figs. 13—17.** *Distacodus expansus* (GRAVES & ELLISON, 1941), p. 555. **Fig. 13.** LO 3607 t. **Fig. 14,** LO 3547 t. **Fig. 15,** same, other side. **Fig. 16.** LO 3608 t. **Fig. 17,** LO 3609 t. All from Yxhult II 7.

**Figs. 18—21.** *Drepanodus proteus* n. sp., p. 566. **Fig. 18,** LO 3610 t, Yxhult II 4. **Fig. 19.** LO 3611 t, Ulunda 2. **Fig. 20,** LO 3612 T, holotype, Yxhult II 3. **Fig. 21,** LO 3613 t, Yxhult II 3.

**Figs. 22, 23.** *Drepanodus latus* n. sp., p. 564. **Fig. 22,** LO 3614 t, Yxhult II 4. **Fig. 23,** LO 3615 T, *holotype*, Stora Backor 8.

**Figs. 24, 25.** *Scolopodus* n. sp., p. 596. **Fig. 24.** LO 3616 t, Lanna 1, postero-oral view. **Fig. 25,** same, side view.

**Fig. 26.** *Oistodus* n. sp., p. 581. LO 3617 t, Lanna 1.

**Figs. 27—29.** *Acodus deltatus altior* n. var., p. 544. **Fig. 27,** LO 3618 t, Tomten 3. **Fig. 28.** same, other side. **Fig. 29,** LO 3619 T, *holotype*, Tomten 3.

**Fig. 30.** *Acodus deltatus* n. sp., p. 544. LO 3620 T, *holotype*, Yxhult II 3.

**Fig. 31.** *Drepanodus longibasis*, n. sp., p. 564. LO 3621 T, *holotype*, Lanna 12.

**Fig. 32.** *Scolopodus rex* n. sp., p. 595. LO 3622 T, *holotype*, Tomten 9.

**Figs. 33, 34.** *Scolopodus rex paltodiformis* n. var., p. 596. **Fig. 33,** LO 3623 T, *holotype*, Tomten 9. **Fig. 34,** same, other side.

**Figs. 35, 36.** *Distacodus rhombicus* n. sp., p. 556. **Fig. 35,** LO 3624 T, *holotype*, Tomten 3. **Fig. 36,** same, other side.

**Figs. 37, 38.** *Oistodus linguatus complanatus* n. var., p. 578. **Fig. 37,** LO 3625 T, *holotype*, Stora Backor 18. **Fig. 38,** LO 3626 t, Stora Backor 18.

**Figs. 39—41.** *Oistodus linguatus* n. sp., p. 577. **Fig. 39,** LO 3627 t, Tomten 6. **Fig. 40,** same, other side. **Fig. 41,** LO 3628 T, *holotype*, Stora Backor 8.

**Fig. 42.** *Oistodus linguatus extenuatus* n. var., p. 578. LO 3629 T, Bjällum 7.

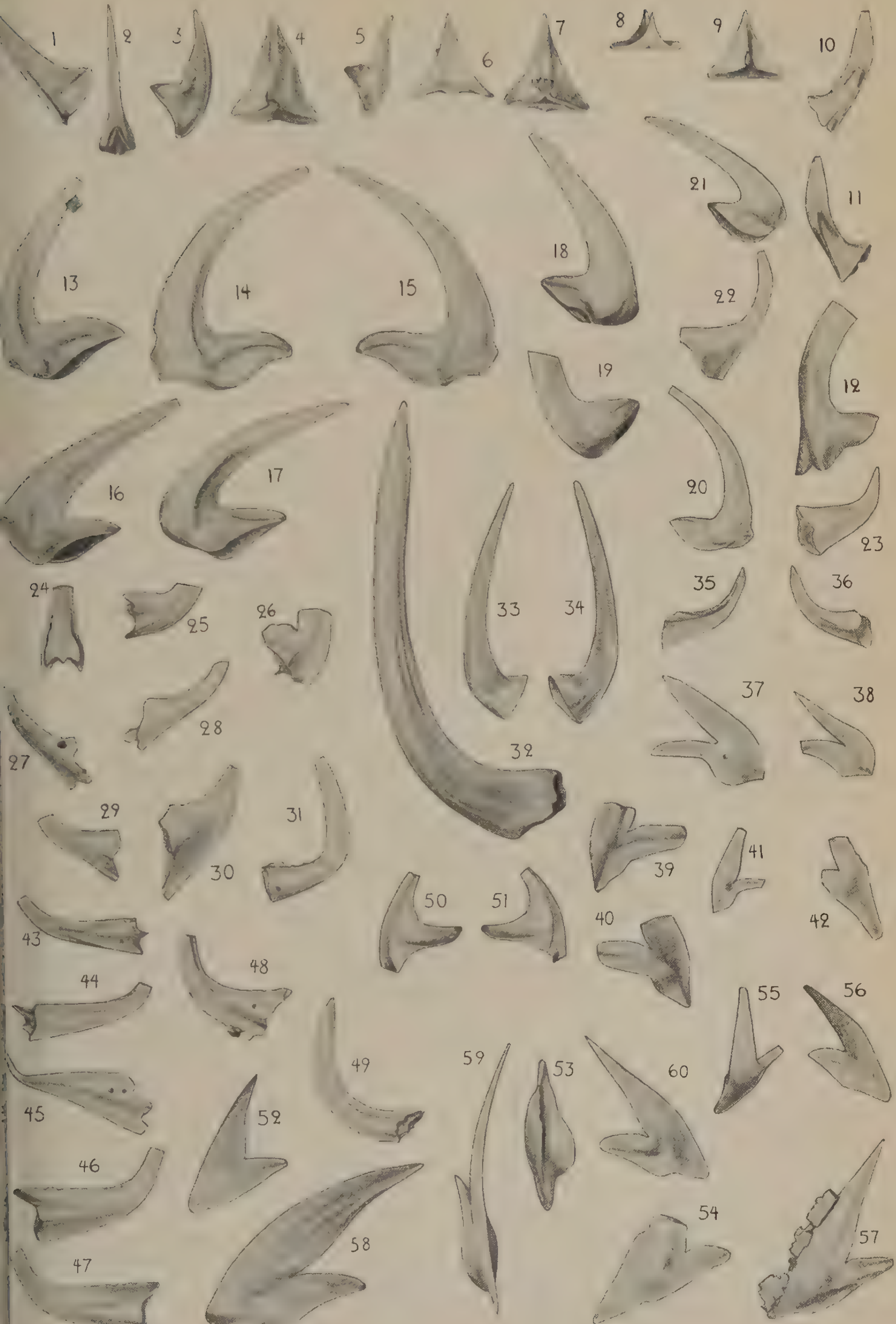
**Figs. 43—49.** *Distacodus stola* n. sp., p. 556. **Fig. 43.** LO 3630 t, **Fig. 44.** same, other side. **Fig. 45,** LO 3631 T, *holotype*, Bjällum 4. **Fig. 46,** LO 3632 t. **Fig. 47,** same, other side. **Fig. 48,** LO 3633 t. **Fig. 49,** LO 3634 t. All except fig. 45 from Yxhult II 7.

**Figs. 50, 51.** *Distacodus stola latus* n. var., p. 557 **Fig. 50,** LO 3635 T, *holotype*, Yxhult II 7. **Fig. 51,** same, other side.

**Figs. 52—57.** *Oistodus inaequalis* PANDER, 1856; p. 576. **Fig. 52.** LO 3636 t, Stora Backor 5. **Fig. 53,** LO 3637 t, Tomten 3, superior view. **Fig. 54,** same, side view. **Fig. 55,** LO 3638 t, Stora Backor 5, superior view. **Fig. 56,** same, side view. **Fig. 57,** LO 3639 t, Yxhult II 4.

**Figs. 58—60.** *Oistodus lanceolatus* PANDER, 1856; p. 577. **Fig. 58,** LO 3640 t. **Fig. 59,** same, superior view. **Fig. 60,** LO 3641 t. All from Yxhult II 7.

PL. III.



## Explanation of Plate IV

All figures × 30.

**Figs. 1, 2.** *Acodus tetrahedron* n. sp., p. 546. **Fig. 1,** LO 3642 T, *holotype*, Stora Backor 5. **Fig. 2,** same, other side.

**Figs. 3—8.** *Paltodus inconstans* n. sp., p. 583. **Fig. 3,** LO 3643 t, Yxhult II 4. **Fig. 4,** same, other side. **Fig. 5,** LO 3644 t, Latorp 5. **Fig. 6,** same, other side. **Fig. 7,** LO 3645 T, *holotype*, Yxhult II 4. **Fig. 8,** same, other side.

**Figs. 9—13.** *Oistodus forceps* n. sp., p. 574. **Fig. 9,** LO 3646 T, *holotype*, Yxhult II 7, superior view. **Fig. 10,** same, side view. **Fig. 11,** LO 3647 t, Bjällum 6. **Fig. 12,** LO 3648 t, Yxhult II 8. **Fig. 13,** same as fig. 10, other side.

**Figs. 14—18.** *Oistodus triangularis* n. sp., 581. **Fig. 14,** LO 3649 T, *holotype*, Yxhult II 7, superior view. **Fig. 15,** same, side view. **Fig. 16,** same, other side. **Fig. 17,** LO 3650 t, Yxhult II 7, superior view. **Fig. 18,** same, side view.

**Figs. 19, 20.** *Oistodus selene* n. sp., p. 580. **Fig. 19,** LO 3651 t, Lanna 10. **Fig. 20,** LO 3652 T, *holotype*, Skultorp 4.

**Figs. 21—25.** *Scandodus rectus* n sp., p. 593. **Fig. 21,** LO 3653 t, Tomten 9. **Fig. 22,** LO 3654 T, *holotype*, Bjällum 6. **Fig. 23,** same, other side. **Fig. 24,** same as fig. 21, posterior view. **Fig. 25,** same, other lateral face.

**Figs. 26—31.** *Oistodus parallelus* Pander, 1856; p. 579. **Fig. 26,** LO 3655 t, Yxhult II 4. **Fig. 27,** LO 3656 t, Stora Backor 5, superior view. **Fig. 28,** same,side view. **Fig. 29,** LO 3657 t, Stora Backor 5. **Fig. 30,** LO 3658 t, Yxhult II 7. **Fig. 31,** LO 3659 t, Yxhult II 7.

**Figs. 32, 33.** *Oistodus elongatus* n. sp., p. 574. **Fig. 32,** LO 3660 t, Lanna 5. **Fig. 33,** LO 3661 T, *holotype*, Lanna 5.

**Fig. 34.** *Drepanodus conulatus* n. sp., p. 561. LO 3662 T, *holotype*, Tomten 7.

**Figs. 35—37.** *Oistodus longiramis*n. sp., p. 579. **Fig. 35,** LO 3663 t, Lanna 6. **Fig. 36.** LO 3664 T, *holotype*, Lanna 6. **Fig. 37,** LO 3665 t, Lanna 6.

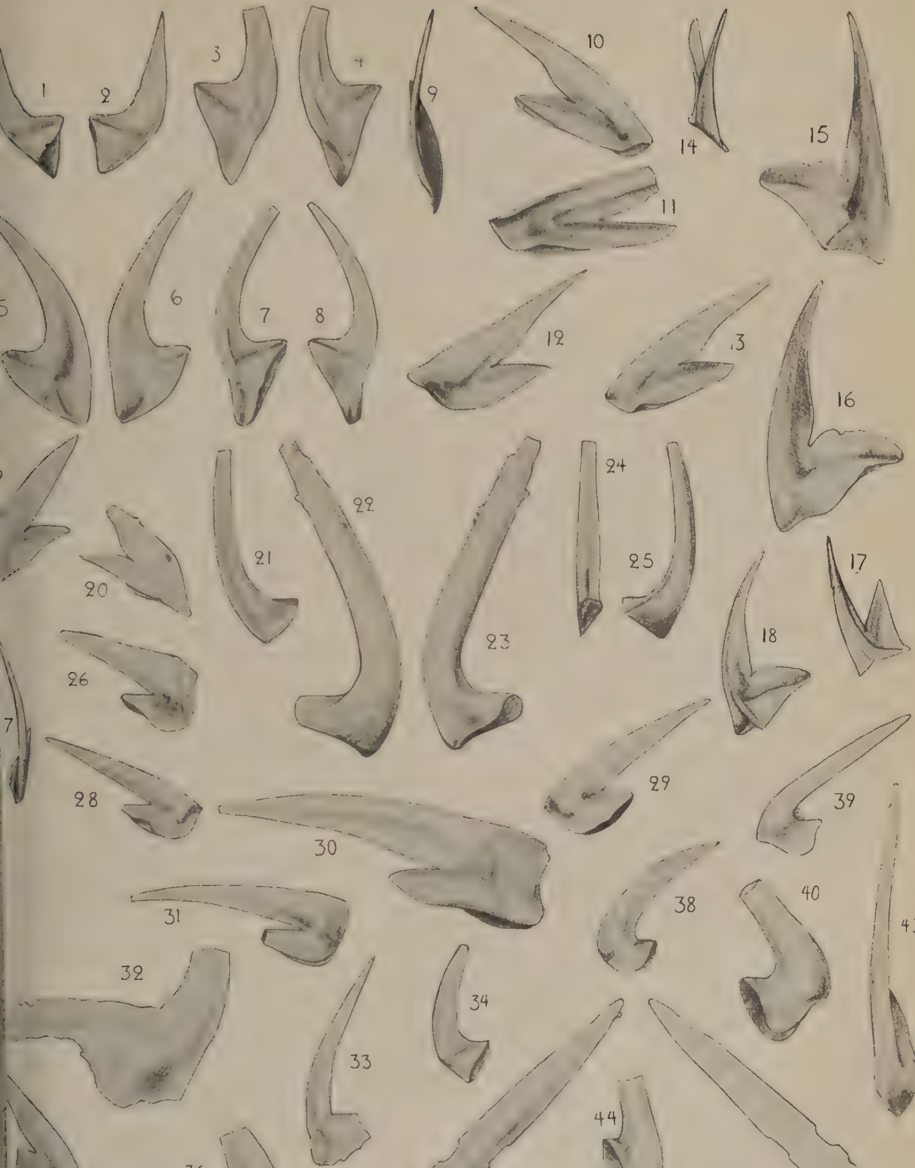
**Figs. 38—42.** *Scandodus pipa* n. sp., p. 593. **Fig. 38,** LO 3666 t, Stora Backor 5. **Fig. 39,** LO 3667 t, Latorp 9. **Fig. 40,** LO 3668 t, Stora Backor 5. **Fig. 41,** LO 3669 T, *holotype*, Bjällum 2. **Fig. 42,** same, other side.

**Fig. 43.** *Oistodus parallelus* Pander, 1856; p. 579. Same as fig. 30, superior view.

**Fig. 44.** *Drepanodus? gracilis* (Branson & Mehl, 1933), p. 562. LO 3670 t, Yxhult II 7.

**Figs. 45, 46.** *Oistodus contractus* n. sp., p. 573. **Fig. 45,** LO 3671 T, *holotype*, Tomten 7. **Fig. 46.** same, other side.

PL. IV.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## Explanation of Plate V

All figures × 30.

**Figs. 1, 2.** *Oistodus gracilis* n. sp., p. 576. **Fig. 1.** LO 3672 T, *holotype*, Latorp 5. **Fig. 2,** LO 3673 t, Latorp 5.

**Fig. 3.** *Scandodus furnishi* n. sp., p. 592. LO 3674 T, *holotype*, Skultorp 1.

**Figs. 4, 5.** *Oncolodus variabilis* n. sp., p. 582. **Fig. 4,** LO 3675 t, Stora Backor 5. **Fig. 5,** same, superior view.

**Figs. 6, 7.** *Drepanodus? gracilis* (Branson & Mehl, 1933), p. 562. **Fig. 6,** LO 3676 t, Yxhult II 3. **Fig. 7,** same, other side.

**Fig. 8.** *Drepanodus cyranoicus* n. sp., p. 561. LO 3677 T, *holotype*, Tomten 7.

**Fig. 9.** *Cordylodus angulatus* Pander, 1856; p. 551. LO 3678 t, Stora Backor 5.

**Figs. 10—13.** *Pravognathus aengensis* n. sp., p. 585. **Fig. 10,** LO 3679 t, Stora Backor 5. **Fig. 11,** LO 3680 t, Stora Backor 5. **Fig. 12,** LO 3681 T, *holotype*, Stora Backor 5. **Fig. 13,** same, other side.

**Figs. 14—16.** *Cordylodus prion* n. sp., p. 552. **Fig. 14,** LO 3682 t, Stora Backor 5. **Fig. 15,** LO 3683 t, Stora Backor 5. **Fig. 16,** LO 3684 T, *holotype*, Stora Backor 5.

**Figs. 17—20.** *Cordylodus rotundatus* Pander, 1856; p. 553. **Fig. 17,** LO 3685 t. **Fig. 18,** LO 3686 t. **Fig. 19,** LO 3687 t. **Fig. 20,** LO 3688 t. All from Stora Backor 5.

**Figs. 21, 22.** *Falodus prodentatus* (Graves & Ellison, 1941), p. 569. **Fig. 21,** LO 3689 t, Tomten 6. **Fig. 22,** same, other side.

**Figs. 23—25.** *Gothodus costulatus* n. sp., p. 569. **Fig. 23,** LO 3690 T, *holotype*, Tomten 7. **Fig. 24,** same, other side. **Fig. 25,** LO 3691 t, Tomten 6.

**Figs. 26—29.** *Prioniodus elegans* Pander, 1856; p. 589. **Fig. 26,** LO 3692 t, Tomten 6, posterior view. **Fig. 27,** same, lateral view. **Fig. 28,** LO 3693 t, Latorp 7, posterior view. **Fig. 29,** same, lateral view.

**Fig. 30.** *Falodus prodentatus* (Graves & Ellison, 1941), p. 569. LO 3694 t, Tomten 6.

**Figs. 31—35.** *Prioniodus navis* n. sp., p. 590. **Fig. 31,** LO 3695 t, Bjällum 6, lateral view. **Fig. 32,** same, anterolateral view. **Fig. 33,** LO 3696 T, *holotype*, Stora Backor 20. **Fig. 34,** LO 3697 t, Bjällum 6, lateral view. **Fig. 35,** same, posterior view.

**Figs. 36, 37.** *Oepikodus crassulus* n. sp., p. 570. **Fig. 36,** LO 3698 T, *holotype*, Tomten 6. **Fig. 37,** LO 3699 t, Stora Backor 19, determination doubtful.

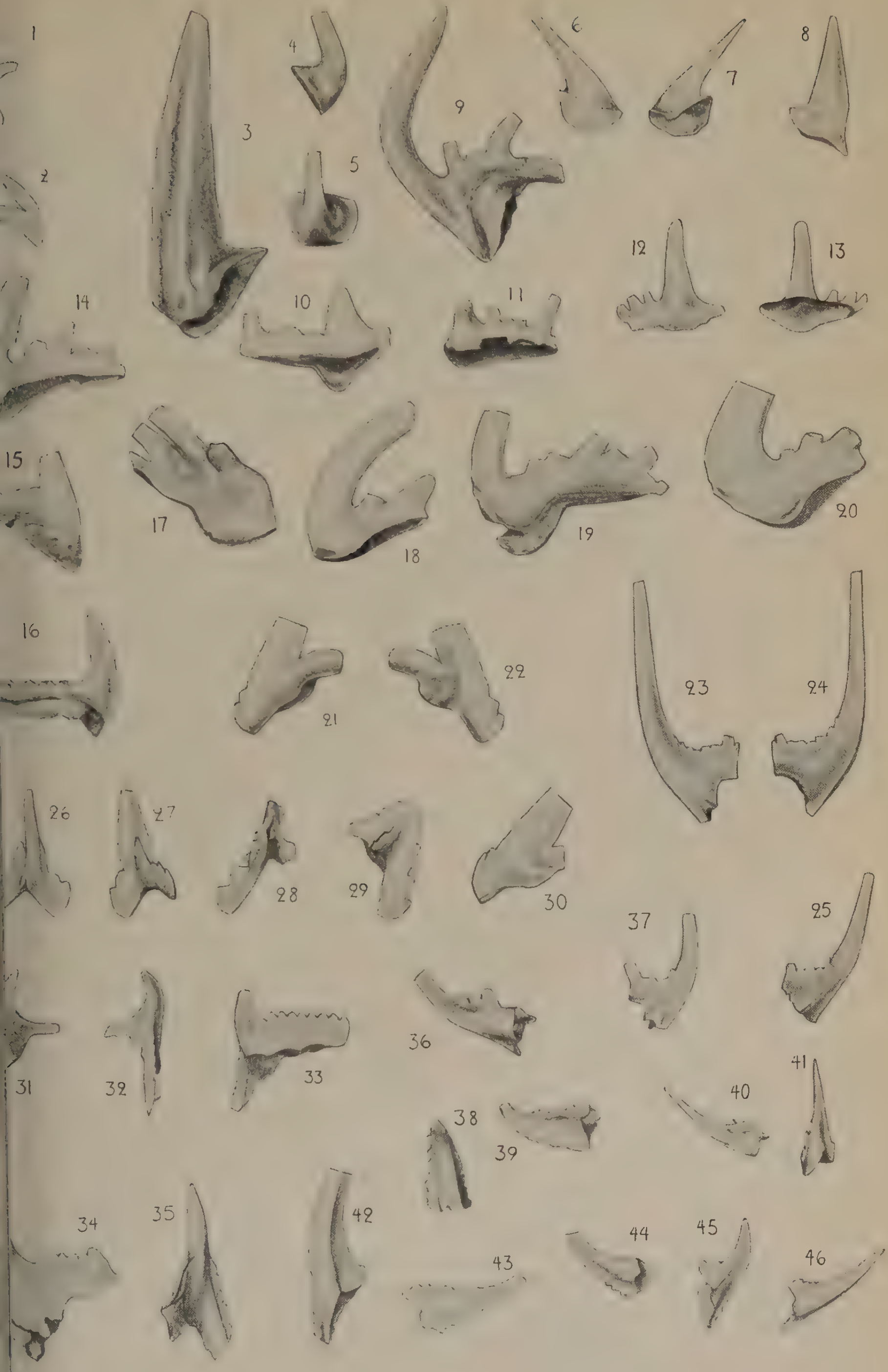
**Figs. 38—41.** *Trapezognathus quadrangulum* n. sp., p. 598. **Fig. 38,** LO 3700 T, *holotype*, Stora Backor 19, superior view. **Fig. 39,** same, side view. **Fig. 40,** LO 3701 t, Stora Backor 19, lateral and slightly superior view, like fig. 39. **Fig. 41,** same, superior view.

**Fig. 42.** *Prioniodus acodiformis* n. sp., p. 591. LO 3702 T, *holotype*, Tomten 6.

**Fig. 43.** *Prioniodina diprion* n. sp., p. 587. LO 3703 T, *holotype*, Skultorp 5.

**Fig. 44.** *Tetraprioniodus denticulatus* n. sp., p. 596. LO 3704 T, *holotype*, Tomten 6.

**Fig. 45, 46.** *Prioniodus triangularis* n. sp., p. 591. **Fig. 45,** LO 3705 t, Bjällum 6. **Fig. 46,** LO 3706 T, *holotype*, Bjällum 6.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## Explanation of Plate VI

All figures × 30.

**Figs. 1—3.** *Oepikodus smithensis* n. sp., p. 571. **Fig. 1,** LO 3707 t, Yxhult II 7, part of posterior process. **Fig. 2,** LO 3708 t, Lanna 6. **Fig. 3,** LO 3709 T, *holotype*, Yxhult II 7.

**Figs. 4—10.** *Prioniodus evae* n. sp., p. 589. **Fig. 4,** LO 3710 t. **Fig. 5,** LO 3711 t. **Fig. 6,** LO 3712 t. All three from Yxhult II 7. **Fig. 7,** LO 3713 T, *holotype*, Yxhult II 7. **Fig. 8,** LO 3714 t, Tomten 6, lateral view. **Fig. 9,** same, posterior view. **Fig. 10,** same, lateral view.

**Figs. 11—12.** *Paracordylodus gracilis* n. sp., p. 584. **Fig. 11,** LO 3715 T, *holotype*, Latorp 5. **Fig.** 12, LO 3716 t, Latorp 5.

**Figs. 13—15.** *Tetraprioniodus robustus* n. sp., p. 597. **Fig. 13,** LO 3717 T, *holotype*, Latorp 3, posterior and slightly inferior view. **Fig. 14,** same, lateral view. **Fig. 15,** same, other lateral view.

**Figs. 16—19.** *Trichonodella longa minor* n. var., p. 601. **Fig. 16,** LO 3718 t, Bjällum 6, lateral view. **Fig. 17,** same, posterior view. **Fig. 18,** LO 3719 T, *holotype*, Bjällum 6, posterior view. **Fig. 19,** same, lateral view.

**Fig. 20.** *Prioniodina densa* n. sp., p. 586. LO 3720 T, *holotype*, Bjällum 6.

**Figs. 21, 22.** *Trichonodella? irregularis* n. sp., p. 600. **Fig. 21,** LO 3721 t, Stora Backor 19, posterior view normal to plane of lateral processes. **Fig. 22,** LO 3722 T, *holotype*, Stora Backor 19, view same as fig. 21.

**Figs. 23—25.** *Prioniodina flabellum* n. sp., p. 587. **Fig. 23,** LO 3723 T, *holotype*, Stora Backor 19. **Fig. 24,** same, other side. **Fig. 25,** LO 3724 t, Stora Backor 19.

**Figs. 26, 27.** *Prioniodina inflata* n. sp., p. 588. **Fig. 26,** LO 3725 t, Tomten 7. **Fig. 27,** LO 3726 T, *holotype*, Lanna 10.

**Figs. 28—30.** *Trichonodella flabellum* n. sp., p. 599. **Fig. 28,** LO 3727 t, Tomten 8, lateral view. **Fig. 29,** same, posterior and slightly superior view. **Fig. 30,** LO 3728 T, *holotype*, Tomten 8, lateral view.

**Figs. 31—35.** *Prioniodina? deflexa* n. sp., p. 586. **Fig. 31,** LO 3729 t, Lanna 10. **Fig. 32,** LO 3730 t, Tomten 7, posterior view. **Fig. 33,** same, lateral view. **Fig. 34,** LO 3731 T, *holotype* Tomten 7. **Fig. 35,** same, other side.

**Figs. 36, 37.** *Cordylodus perlongus* n. sp., p. 552. **Fig. 36,** LO 3732 t, Stora Backor 19. **Fig. 37,** LO 3733 T, *holotype*, Stora Backor 19.

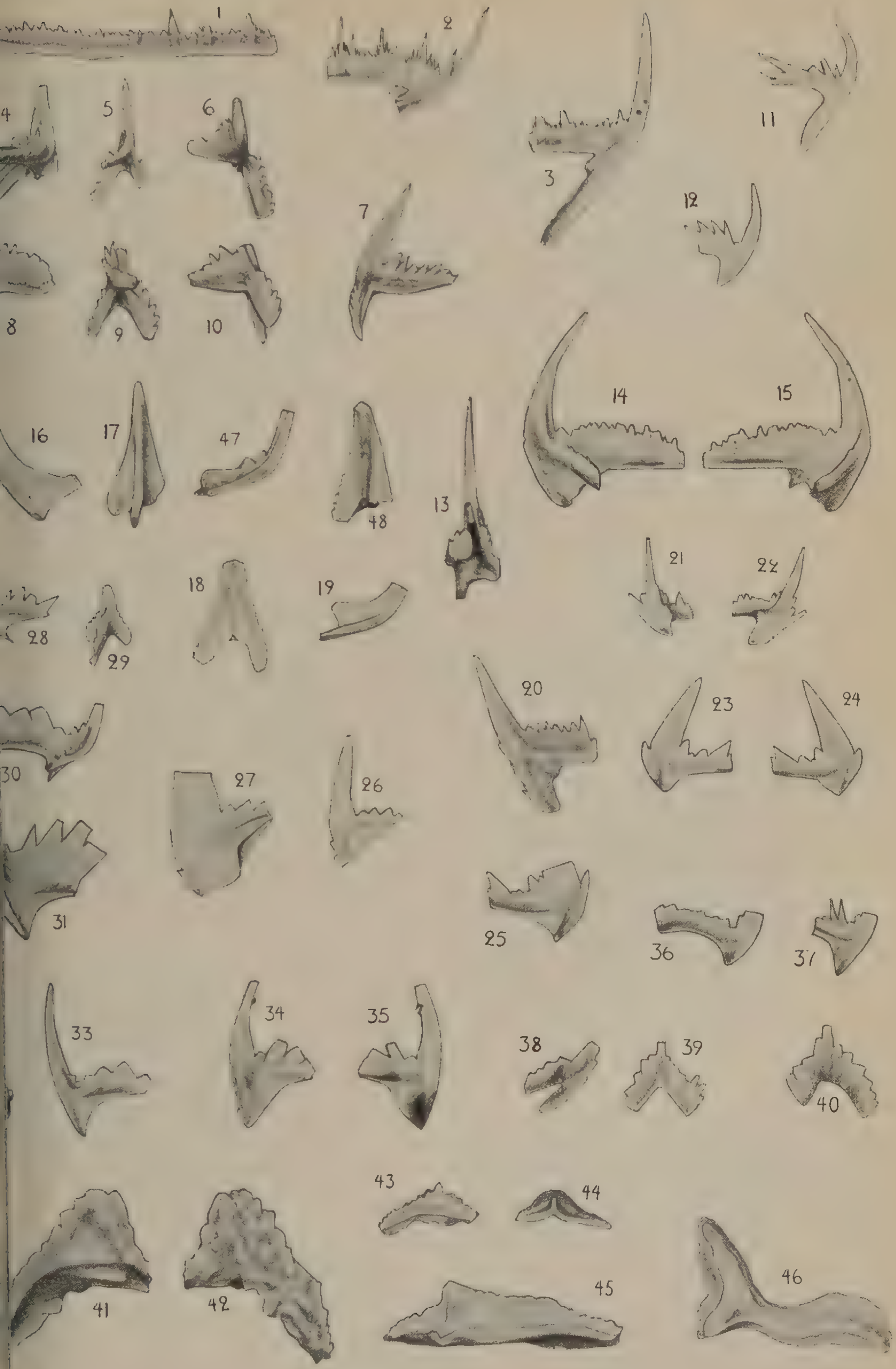
**Figs. 38—40.** *Trichonodella alae* n. sp., p. 599. **Fig. 38,** LO 3734 T, *holotype*, Bjällum 5, lateral and slightly posterior view. **Fig. 39,** LO 3735 t, Stora Backor 19, anterior view. **Fig. 40,** same as fig. 38, anterior view.

**Figs. 41, 42.** *Nericodus capillamentum* n. sp., p. 570. **Fig. 41,** LO 3736 T, *holotype*, Yxhult II 4, lateral view. **Fig. 42,** other lateral view.

**Figs. 43, 44.** N. gen. N. sp., p 601. **Fig. 43,** LO 3737 t, Yxhult II 7, inner lateral view. **Fig. 44,** same, superior view.

**Figs. 45, 46.** *Ambolodus* n. sp., p 550. **Fig. 45,** LO 3738 t, Stora Backor 5, lateral view. **Fig. 46,** same, superior view.

**Figs. 47, 48.** *Trichonodella longa* n. sp., p. 600. **Fig. 47,** LO 3739 T, *holotype*, Tomten 6, lateral view. **Fig. 48,** same, superior view.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## Explanation of Plate VII

Specimens photographed with transmitted light.

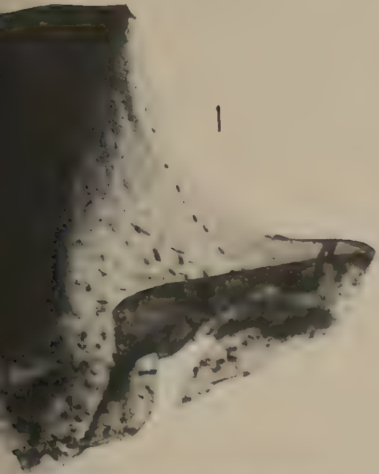
**Fig. 1.** *Drepanodus arcuatus* Pander. LO 3740 t. Showing basal canalules arranged in longitudinal rows. × 135.

**Figs. 2—4.** *Oistodus triangularis* n. sp. LO 3741 t. Ground section. **Fig. 2.** entire specimen showing location of the details, figs. 3 & 4. × 50. **Fig. 3.** laminated phosphate filling of basal cavity. Detail from the center of the lower circle, fig. 2. + Nicols. × 600. **Fig. 4.** the filling at the tip of the basal cavity, upper circle of fig. 2. × 600.

**Figs. 5, 6.** *Drepanodus sculponea* n. sp. LO 3742 t. Showing profuse development of basal canalules. **Fig. 5,** entire view, with location of fig. 6. × 75. **Fig. 6,** detail of former. × 210.

**Fig. 7.** *Scolopodus rex* n. sp. LO 3743 t. Ground section. Sub-apical part of cusp, with vesiculate growth axis and well-developed growth laminae. + Nicols. × 210.

Photographs by J. v. Feilitzen.



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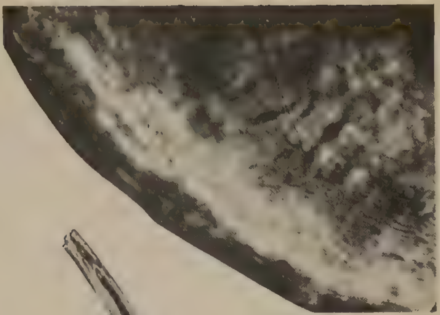

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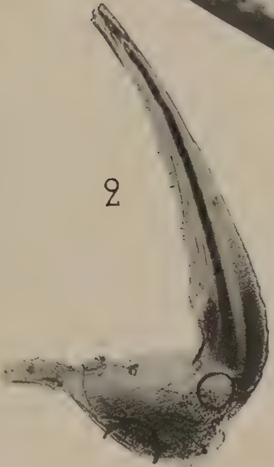

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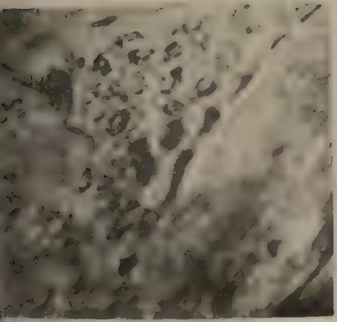

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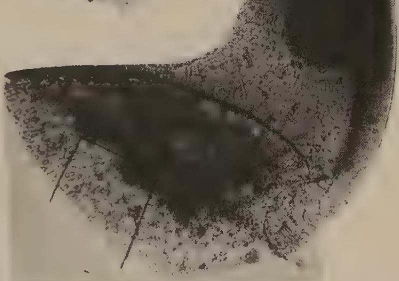
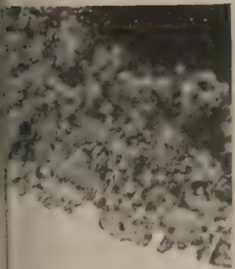
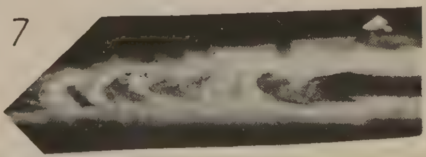


5



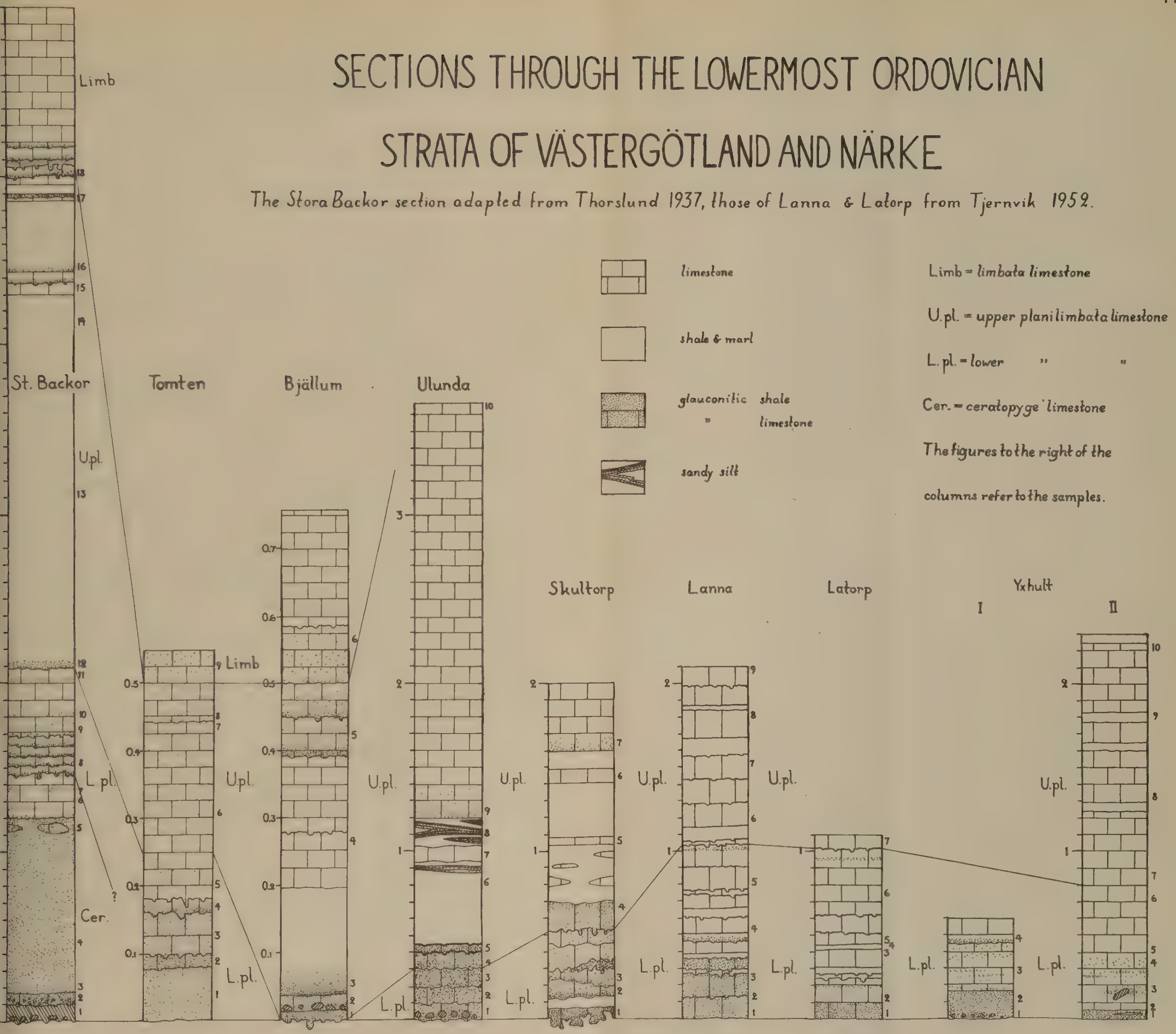
6



7

# SECTIONS THROUGH THE LOWERMOST ORDOVICIAN STRATA OF VÄSTERGÖTLAND AND NÄRKE

*The Stora Backor section adapted from Thorslund 1937, those of Lanna & Latorp from Tjernvik 1952.*



Limb = limbata limestone

U.pl. = upper planilimbata limestone

L.pl. = lower " "

Cer. = ceratopyge limestone

The figures to the right of the columns refer to the samples.

| | Stora Backor | | | | | | | | | | | | | | | | Tomten | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 15 | 16 | 18 | 19 | 20 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus pulcher* n. sp. | | | | 8 | | | | | | | | | | | | | | | | | | | | | |
| *tetrahedron* n. sp. | | | | 9 | 2 | 1 | | | | | | | | | | | | | | | | | | | |
| *Ambolodus* n. sp. | | | | 1 | | | | | | | | | | | | | | | | | | | | | |
| *Cordylodus angulatus* Pander | 6 | 4 | 15 | 48 | | | 2 | | | | | | | | | | | 2 | | | | | | | |
| *prion* n. sp. | 1 | 1 | 3 | 8 | | | | | | | | | | | | | | | | | | 1 | | | |
| *rotundatus* Pander | 1 | 3 | 4 | 33 | | | 1 | | | | | | | | | | 2 | | | | 2 | | | | |
| *Distacodus peracutus* n. sp. | | 1 | | 5 | | | 3 | | | | | | | | | | | | 2 | | | | | | |
| *Drepanodus amoenus* n. sp. | 2 | | | 71 | 2 | | | | | | | | | | | | | | | | | | | | |
| *arcuatus* Pander | | | | 9 | 1 | 2 | 14 | | 5 | | 12 | | | | | | | 30 | 25 | 24 | 22 | 16 | | 6 | 1 |
| *deltifer* n. sp. | | 1 | | 22 | 1 | 2 | | | | | | | | | | | | | | | | | | | |
| *numarcuatus* n. sp. | | | | 32 | 1 | 2 | | | | | | | | | | | | | | | | | | | |
| *sculponea* n. sp. | | | | 1 | | 3 | 3 | | 2 | | 9 | 1 | | | | 1 | | 9 | | 5 | 11 | 2 | | 1 | 1 |
| cf. *subarcuatus* Furnish | | | 5 | 6 | | | | | | | 2 | | | | | | | | | | | | | | |
| *Oistodus inaequalis* Pander | 1 | 1 | | 21 | 1 | | 8 | | 1 | | | | | | | | | 16 | 12 | 2 | | | | | |
| *parallelus* Pander | | | 2 | 55 | 2 | 8 | 28 | | 4 | 2 | 19 | 1 | | | | 5 | 1 | 55 | 26 | 18 | 19 | 4 | | 1 | |
| *Oneotodus variabilis* n. sp. | 3 | | 6 | 29 | | | | | | | | | | | | | | | | | | | | | |
| *Pravognathus aengensis* n. sp. | | 1 | | 2 | | | | | | | | | | | | | | | | | | | | | |
| *Scandodus pipa* n. sp. | | | | 20 | 2 | 2 | 20 | 1 | 2 | 2 | 2 | 1 | | | | | 1 | 17 | 16 | 10 | 17 | 13 | 5 | 6 | |
| *Scolopodus peselephantis* n. sp. | | | 1 | | | | | | | | | | | | | | 1 | 2 | 1 | | | | | | |
| II | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus deltatus* n. sp. | | | | | | | 1 | | | | | | | | | | | 5 | 3 | | | | | | |
| *deltatus altior* n. var. | | | | | | | 1 | | | | | | | | | | | 2 | 1 | | | | | | |
| *Distacodus rhombicus* n. sp. | | | | | | | | | | | | | | | | | | 3 | | | | | | | |
| *Drepanodus* cf. *arcuatus* Pander | | | | | 1 | | 3 | | 1 | | 2 | | | | | | | 2 | 2 | 8 | 6 | 2 | 2 | | |
| *conulatus* n. sp. | | | | 1 | | | | | | | | | | | | | | 11 | 4 | | | 2 | | | |
| *cyranoicus* n. sp. | | | | | | | | | | | 1 | | | | | | | 1 | | | | 1 | | | |
| ? *gracilis* (Branson & Mehl) | | | | | | | 2 | | 1 | | | | | | | | | 4 | 3 | | 4 | 2 | 1 | 2 | |
| *homocurvatus* n. nom. | | | | | | | | | | 1 | 3 | 3 | | 3 | 5 | 2 | | | 10 | 6 | 18 | 29 | 1 | 29 | |
| *latus* n. sp. | | | | | | | 1 | | | 1 | | | | | | | | 3 | 2 | | | | | | |
| *proteus* n. sp. | | | | | | | 40 | 1 | | | | | | | | | 1 | 16 | 24 | 7 | 2 | | | | |
| *Nericodus capillamentum* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oistodus elongatus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *forceps* n. sp. | | | | | | | | 1 | | | 5 | 5 | | 8 | 10 | | | | 3 | 2 | 32 | 36 | 32 | 82 | 3 |
| *gracilis* n. sp. | | | | | | | | | | 4 | | | | | | | | | | | | | | | |
| *linguatus* n. sp. | | | | | | | 1 | | | | | | | | | | | 1 | | | 5 | | 1 | 1 | |
| n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Paltodus inconstans* n. sp. | | | | | | | 11 | | 2 | | | | | | | | | 19 | 21 | 10 | 4 | 1 | | | |
| *Paracordylodus gracilis* n. sp. | | | | | | | | | 1 | 2 | | | | | | | | | | | | | | | |
| *Scandodus furnishi* n. sp. | | | | 2 | | | | | | | 1 | | | 1 | | | | 3 | 5 | 1 | | | | | |
| n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scolopodus* n. sp. | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| *Tetraprioniodus robustus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | |

| | Bjällum | | | | | | | | | | | | | Ulunda | | | | | | | | Skultorp | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 1 | 2 | 3 | 4 | 5 | 7 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus pulcher* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *tetrahedron* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Ambolodus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Cordylodus angulatus* Pander | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | |
| *prion* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *rotundatus* Pander | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | |
| *Distacodus peracutus* n. sp. | | | | | | | | | | | | | | | 1 | | | | | | | 2 | | | | | | |
| *Drepanodus amoenus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *arcuatus* Pander | 7 | 8 | 11 | 7 | 3 | 3 | 3 | 10 | | 2 | 3 | | | | 7 | 5 | 3 | 6 | 3 | 5 | 5 | 4 | 2 | | 8 | | 1 | 10 |
| *deltifer* n. sp. | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | |
| *numarcuatus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *sculponea* n. sp. | | 8 | 6 | 2 | | | | 7 | | | 2 | | | | 16 | 3 | 5 | 6 | | 4 | | 5 | 1 | 1 | 11 | | | 4 |
| cf. *subarcuatus* Furnish | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oistodus inaequalis* Pander | | | | | | | | | | | | | | | 2 | 1 | | | | | | 4 | | | | | | |
| *parallelus* Pander | 8 | 8 | 13 | 10 | 2 | | 1 | 1 | | | | | | | 7 | 9 | 8 | 5 | | | | 8 | 2 | 1 | 12 | 1 | 1 | |
| *Oneotodus variabilis* n. sp. | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *Pravognathus aengensis* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scandodus pipa* n. sp. | 2 | 3 | 8 | 5 | | 2 | | 7 | | | 1 | | | | 5 | 5 | 1 | 3 | 1 | 1 | 1 | 9 | 1 | 1 | 9 | 2 | 5 | 6 |
| *Scolopodus peselephantis* n. sp. | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | |
| II | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus deltatus* n. sp. | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | | |
| *deltatus altior* n. var. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Distacodus rhombicus* n. sp. | | | | | | | | | | | | | | | 3 | | | | | | | 1 | | | | | | |
| *Drepanodus* cf. *arcuatus* Pander | | 3 | 2 | 3 | | 3 | 1 | | | 1 | 1 | | | | 12 | 8 | 1 | | | 2 | | 3 | | | 5 | | | 1 |
| *conulatus* n. sp. | | | | | | | | | | | | | | | | | 2 | | | | | 4 | | | | | | 2 |
| *cyranoicus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| ? *gracilis* (Branson & Mehl) | | | 2 | | | 1 | | 2 | | | 1 | | | | | 1 | | 2 | | | | 1 | | | | | | |
| *homocurvatus* n. nom. | | 3 | 8 | | 5 | 1 | 5 | 15 | 8 | 8 | 15 | | | | 9 | 3 | 7 | | 6 | 3 | 3 | 7 | | | | 3 | 1 | 10 |
| *latus* n. sp. | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *proteus* n. sp. | | | 2 | | | | | | | | | | | | 11 | 8 | | | 1 | | | 13 | | 1 | | | | 3 |
| *Nericodus capillamentum* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oistodus elongatus* n. sp. | | | | | | | | | | | | | | | 2 | | | | | | | | | | 3 | | | |
| *forceps* n. sp. | 1 | 3 | 19 | 9 | 18 | 12 | 11 | 71 | 10 | 17 | 56 | 5 | 1 | | | 2 | 6 | 9 | 15 | 18 | 11 | | | | 3 | 3 | 7 | 31 |
| *gracilis* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *linguatus* n. sp. | | | | | | | 1 | 3 | | | 2 | 1 | | | | | | | | | | | | | | | | |
| n. sp. | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | |
| *Paltodus inconstans* n. sp. | 1 | | 1 | | | | | | | | | | | | 2 | 3 | | | | | | 4 | 1 | 1 | | | | |
| *Paracordylodus gracilis* n. sp. | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | |
| *Scandodus furnishi* n. sp. | | | | 1 | 1 | | | 2 | | | | | | | | | | | | | | 2 | | | | | | 2 |
| n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scolopodus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tetraprioniodus robustus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | Lanna | | | | | | | | | | | Latorp | | | | | | | I | | | | Yxhult II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus pulcher* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *tetrahedron* n. sp. | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Ambolodus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Cordylodus angulatus* Pander | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | |
| *prion* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *rotundatus* Pander | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Distacodus peracutus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *Drepanodus amoenus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *arcuatus* Pander | 13 | 13 | 7 | 9 | 3 | | 1 | 2 | 4 | 2 | 3 | 17 | 8 | 2 | | 5 | 2 | 1 | 3 | 6 | 2 | 4 | 2 | 5 | 7 | 3 | | | | 2 | 1 |
| *deltifer* n. sp. | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | |
| *numarcuatus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *sculponea* n. sp. | 3 | 11 | 7 | 5 | | | | 1 | 2 | 2 | | 3 | 15 | 4 | | 11 | | 3 | | | 1 | 4 | 3 | 6 | 3 | 5 | | | 1 | 1 | |
| cf. *subarcuatus* Furnish | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oistodus inaequalis* Pander | 5 | 1 | 1 | | | | | | | | | 2 | 7 | 1 | | 1 | | | | | | | 1 | 4 | 5 | 1 | | | | | |
| *parallelus* Pander | 5 | 11 | 13 | 16 | 6 | | | | | | | 19 | 18 | 6 | 3 | 4 | 3 | 6 | 3 | | 4 | 8 | | 14 | 18 | 2 | 4 | 16 | | | |
| *Oneotodus variabilis* n. sp. | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| *Pravognathus aengensis* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scandodus pipa* n. sp. | 7 | 9 | 7 | 6 | 2 | | 1 | | | | | 5 | 10 | 3 | 1 | 6 | 1 | 3 | 2 | 3 | 5 | 4 | 2 | 12 | 6 | 1 | 2 | | | | |
| *Scolopodus peselephantis* n. sp. | | | | | | | | | | | | 4 | 4 | | | | | | | | | | | | | | | | | | |
| II | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus deltatus* n. sp. | | | | 3 | | | | | | | | | | | | | | | | | | | | 2 | 3 | | | | | | |
| *deltatus altior* n. var. | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Distacodus rhombicus* n. sp. | | | | 2 | | | | | | | | 1 | | | | | | | | | | | 1 | 1 | 1 | | | | | | |
| *Drepanodus* cf. *arcuatus* Pander | | 1 | 3 | 6 | 3 | | | | | | | 9 | 10 | 1 | | 7 | | 1 | | | | 3 | 4 | 9 | 3 | 7 | | | | | |
| *conulatus* n. sp. | | | 1 | | | | | | 1 | | | | | | | 1 | | | 1 | | | | | | 1 | | | 2 | 2 | 1 | |
| *cyranoicus* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ? *gracilis* (Branson & Mehl) | | 3 | | | | | | | | | | | 3 | 1 | | | | 1 | | | | | | 3 | 1 | | | 3 | | | |
| *homocurvatus* n. nom. | 5 | 3 | 1 | 2 | | 2 | | | 3 | | 5 | 7 | 10 | 1 | | 3 | | 1 | 1 | | 3 | | | 9 | 5 | 1 | | 5 | 7 | | |
| *latus* n. sp. | | | | 2 | | | | | | | | | | | | | | | | | | 1 | | | 1 | | | | | | |
| *proteus* n. sp. | 10 | 5 | 10 | 24 | | | | | | | | 11 | 25 | 16 | 1 | 7 | 3 | 1 | | | 2 | | 1 | 46 | 27 | | 2 | | | | |
| *Nericodus capillamentum* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *Oistodus elongatus* n. sp. | | | | 4 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| *forceps* n. sp. | | | | | 1 | 3 | | 6 | 9 | 1 | 19 | | | 2 | 1 | 4 | | 7 | | | | | | 1 | 1 | | | 41 | 20 | 4 | 5 |
| *gracilis* n. sp. | | | | | | | | | | | | | | 1 | | 5 | | | | | | | | | | | 1 | | | | |
| *linguatus* n. sp. | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Paltodus inconstans* n. sp. | | 4 | 3 | | | | | | | | | | 3 | 2 | 2 | 7 | | | | | 3 | 3 | | 11 | 16 | 1 | 1 | | | | |
| *Paracordylodus gracilis* n. sp. | | | | | | | | | | | | | | 10 | | 14 | | | | | | | | | | | 1 | | | | |
| *Scandodus furnishi* n. sp. | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | 2 | | | | 1 | | | |
| n. sp. | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | |
| *Scolopodus* n. sp. | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tetraprioniodus robustus* n. sp. | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | |

| | Stora Backor | | | | | | | | | | | | | | | | Tomten | | | | | | | | | Bjällum | | | | | | | | | | | | | Ulunda | | | | | | | | Skultorp | | | | | | | Lanna | | | | | | | | | | | Latorp | | | | | | | I | | | | Yxhult II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 15 | 16 | 18 | 19 | 20 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 1 | 2 | 3 | 4 | 5 | 7 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| III | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acodus gladiatus* n. sp. | | | | | | | | | | | | | | | | | | | 5 | 2 | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 2 | | 1 | | | | | | | | | | | | | | | | | | | | | 10 | 2 | | | | |
| *gratus* n. sp. | | | | | | | | | | | 2 | 3 | | | | | | | | | 1 | | | | | 1 | | | | | | 1 | 4 | 6 | | | | | | 2 | | 2 | | | | | | 2 | 1 | 3 | | | | | | 1 | | | | | | 2 | | | | | | | | | | | | | | | | | 10 | | | | | |
| *Acontiodus arcuatus* n. sp. | | | | | | | | 1 | | | | | | | | | | 3 | 6 | 1 | | | 2 | 2 | 2 | 1 | | | | 5 | | 2 | | | | | | | | | | | 4 | | | | | 1 | | 1 | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | 19 | | | | | |
| *reclinatus* n. sp. | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | 1 | 1 | | | | | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | 7 | | | | | |
| *rectus* n. sp. | | | | | | | | 2 | | | 5 | 14 | 2 | | | | | 9 | 15 | 4 | 103 | 1 | | 2 | 3 | 2 | 14 | 4 | 22 | 63 | 30 | 26 | 74 | 8 | 3 | | | | 6 | 13 | 7 | 18 | 10 | | | | | 2 | 3 | 11 | | | | | 5 | | | 9 | 5 | 2 | 40 | | | | | | | | | | | | | | | | | 29 | 21 | 6 | 1 | | |
| *rectus sulcatus* n. var. | | | | | | | | 1 | | | | | | | | | | 2 | | | | | | 1 | 2 | | | | | 1 | | | | | | | | | | | | 2 | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Distacodus expansus* (Graves & Ellison) | | | | | | 1 | 3 | 4 | 2 | | | | 1 | | 1 | | 2 | 28 | 10 | | 1 | | | 7 | 13 | 2 | | | | 1 | | | 1 | | | | | 6 | 8 | 9 | | | | | | | 15 | 8 | 4 | 3 | | | | 14 | 6 | | | | 1 | 3 | | | | 1 | 1 | 3 | | | | | | | | | | | | 100 | | | | | |
| *stola* n. sp. | | | | | | | | 1 | | | 1 | | | | | | | 12 | 2 | | | | | | 1 | 1 | 10 | 2 | | | | | | | | | | | 2 | 3 | 1 | | 5 | | | | 1 | 4 | 2 | | | | | | 6 | 2 | | 1 | | | | | | | | 1 | | | | | | | | | 2 | | | 24 | 6 | | | | |
| *stola latus* n. var. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | 1 | | | | | | | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | | | | |
| *Drepanodus longibasis* n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 4 | | | | | | | | | | | 1 | 1 | 2 | | | | | | 1 | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | | |
| *planus* n. sp. | | | | | | | | 4 | 7 | | 11 | 5 | | | | | | 4 | 22 | 20 | 53 | | | 5 | 5 | 5 | 26 | 24 | 14 | 80 | 34 | 51 | 75 | | 11 | | | | 8 | 7 | 15 | 17 | 41 | | | | 2 | 7 | 6 | 8 | | | | | 14 | | | | 19 | 2 | 31 | | | 4 | | 3 | | 1 | | | | 2 | | | 2 | | | 58 | 36 | 24 | 13 | | |
| *suberectus* (Branson & Mehl) | | | | | 1 | | | | 1 | | | | | 1 | | | 1 | | 1 | 5 | 5 | 9 | 1 | | | 2 | | 1 | 1 | 1 | | 4 | 5 | 1 | | 1 | | | | 1 | 1 | | 1 | 2 | | | | | 2 | | 3 | | | | | | | | | | 3 | | | 1 | | | | | | | | | | | | | | 8 | 2 | 1 | 1 | | |
| *Falodus prodentatus* (Graves & Ellison) | | | | | | | | 3 | | | | | | | | | | 4 | | | | | | | | 1 | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Gothodus costulatus* n. sp. | | | | | | | | | | | | | | | | | | 4 | 2 | | | | | | | | | | | | | | | | | | | | 2 | 1 | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oepikodus crassulus* n. sp. | | | | | | | | | | | | 1 | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *smithensis* n. sp. | | | | | | | | 12 | | | | | | | | | | 58 | 21 | 3 | | | 5 | 11 | 30 | 14 | | | 1 | | | 1 | 1 | | | | | | 12 | 20 | 1 | 1 | | | | | 4 | 18 | 5 | | | | | | 48 | | | | | | | | | | | | | 1 | | | | | | | | | | 14 | | | | | |
| *Oistodus contractus* n. sp. | | | | | | | | | | | | | | | | | | | 3 | | 2 | | | | | | | 1 | | 1 | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 2 | | | | | | | | | | | | | | | | | | 1 | | | | |
| *delta* n. sp. | | | | | | | | | 1 | | | | | | | | | 5 | 2 | 1 | 1 | | 1 | | 1 | | | 1 | | | | | | | | | | | | 1 | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | |
| *lanceolatus* Pander | | | | | | | | 3 | 5 | | | | | | | | | 28 | 17 | | 3 | | 1 | 4 | 6 | 6 | 2 | 9 | 6 | 8 | 1 | | | | | | | | 4 | 1 | 13 | 7 | 7 | | | | 3 | 8 | 6 | 6 | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | 9 | 4 | | | | |
| *longiramis* n. sp. | | | | | | | | | | | | | | | | | | 5 | 2 | | | 1 | 1 | 3 | 5 | 4 | 1 | | | | 1 | | | | | | | | 3 | 7 | | | | | | | | 5 | 1 | | | | | | 22 | 1 | | | | | | | | | | | | 2 | | | | | | | | | | 6 | | | | | |
| *selene* n. sp. | | | | | | | | | 1 | | | | | | | | | 5 | 6 | | | | | 2 | 3 | 2 | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | | | 2 | | | 2 | | | | 5 | | | | | | | | | 4 | | | | | | | | | | | | | | | |
| *triangularis* n. sp. | | | | | | | 1 | | 3 | | | | | | | | | 15 | 11 | 6 | 1 | | 1 | 3 | 9 | 2 | 5 | 6 | 3 | 10 | 1 | | | | | | | 1 | 7 | 1 | 7 | 2 | 6 | | | | | 2 | 2 | 8 | | | | | 3 | 1 | | 4 | 2 | | 1 | | | | | | | | | | | | | | | | | 35 | 2 | | 1 | | |
| *Prioniodina ? deflexa* n. sp. | | | | | | | | | 2 | | 1 | | | | | | | 3 | 7 | 3 | 5 | | 1 | 2 | | | 1 | | 1 | 3 | | 3 | 9 | | | | | | 1 | 1 | 2 | 2 | 1 | | | | | | | 9 | | | | | | | 4 | | 2 | 3 | 2 | | | | | | | | | | | | | | | | | | | | | | | |
| *diprion* n. sp. | | | | | | | | | | | 1 | | | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *inflata* n. sp. | | | | | | | | | 1 | | | | | | | | | 2 | 8 | 5 | | | | | | 1 | | | 1 | 1 | 1 | | 4 | | | | | | 1 | 1 | 1 | 2 | 1 | | | | | | | 2 | | | | | | 1 | | | 1 | 2 | 1 | | | | | | | | | | | | | | | | | | | | 5 | | |
| *Prioniodus elegans* Pander | | | | | | 1 | | | 6 | | | | | | | | | 3 | | | | | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | | |
| *evae* n. sp. | | | | | | | | | | | | | | | | | | 128 | 35 | 3 | 1 | | 8 | 21 | 35 | 3 | | 1 | | | 1 | 2 | 2 | | | | | 1 | 18 | 20 | 2 | | | | | | | 23 | 6 | 1 | | | | | 28 | 1 | 1 | | | | | | | | | | | 1 | | | | | | | | | | 25 | | | | | |
| *acodiformis* n. sp. | | | | | | | | | | | | | | | | | | 4 | 3 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Scandodus rectus* n. sp. | | | | | | | | | 1 | | 2 | 2 | 1 | | | | | 2 | 8 | 7 | 21 | 1 | 1 | 1 | 2 | 2 | 5 | 2 | 4 | 17 | 4 | 8 | 24 | | 1 | | | | 4 | 1 | 4 | 7 | 6 | | | | | 3 | | 6 | | | | | | | 2 | | 1 | | 7 | | | | | | | | | | | | | | | | | 6 | 1 | 1 | | | |
| *Scolopodus rex* n. sp. | | | | | | | | 2 | | | 1 | | | | | | | 3 | 1 | | 10 | | | 2 | | 2 | | 1 | | 2 | 1 | 6 | 4 | 1 | 2 | | | | 1 | | 1 | | | | | | | | | | | | | 1 | | | 2 | 1 | 1 | | 2 | | | | | | | | | | | | | | | | | 2 | | | | | |
| *rex paltodiformis* n. var. | | | | | | | | | | | | | | | | | | 1 | | 1 | 3 | | | | | | | | | | 1 | 2 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| *Tetraprioniodus denticulatus* n. sp. | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Trapezognathus quadrangulum* n. sp. | | | | | | | | | | | 1 | 3 | 1 | | | | | | 1 | | 2 | 1 | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| *Trichonodella alae* n. sp. | | | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *flabellum* n. sp. | | | | | | | | 2 | 2 | | 2 | | | | | | | 5 | 5 | 6 | 4 | | 1 | | | 1 | 1 | | | 2 | 1 | | | | | | | | 1 | | 1 | 1 | | | | | | 1 | | 5 | | | | | | | | | 1 | | 1 | | | | | | | 2 | | | | | | | | | | | | | 1 | | |
| *longa* n. sp. | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N. gen. n. sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| IV | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Cordylodus perlongus* n. sp. | | | | | | | | | | | 1 | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oistodus linguatus complanatus* n. var. | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *linguatus extenuatus* n. var. | | | | | | | | | | | 1 | | | | | | | | | | | 1 | | | | | | | | | | | | 1 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prioniodina densa* n. sp. | | | | | | | | | | | | 2 | 1 | | | | | | | | | 1 | | | | | | | | | 1 | 1 | 1 | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *flabellum* n. sp. | | | | | | | | | | | 1 | 28 | | | | | | | | | | 1 | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prioniodus navis* n. sp. | | | | | | | | | | | 2 | 7 | 3 | | | | | | | | 3 | 3 | | | | | | | | | 5 | 2 | 8 | 1 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *triangularis* n. sp. | | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | 2 | 1 | 3 | 2 | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | |
| *Trichonodella irregularis* n. sp. | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *longa minor* n. var. | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | | 4 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

TRYCKT VID AB KARTOGRAFISKA INSTITUTET
ESSELTE AB STOCKHOLM 1954

# Om lias-sandstenen vid Brandsberga och Kolleberga

Av

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*Abstract.* On the Liassic sandstone at Brandsberga and Kolleberga. 1. At Brandsberga, situated in the Archean part of the Engelholm through of N. W. Scania (TROEDSSON 1951), a great many fossiliferous pebbles of sandstone were met with in 1880 during the mapping of the geological sheet »Trolleholm». The fauna was described by LUNDGREN (1881) and referred to the Hettangian.

Laying stress upon the occurrence in the Brandsberga fauna of *Trigonia primaeva* TROEDSSON, the advanced paucicostate form *Oxytoma scanica* (LUNDGREN), and 5 additional species, common to the fauna of the Lower Pliensbachian of Katslösa, the present author (1938, 1951) claimed the age of the Brandsberga sandstone to be much later than the Hettangian probably Lower or even Upper Pliensbachian.

The statement of H. HÖLDER, that a badly preserved internal natural mould of *Oxytoma*, found in the *Planorbis* zone at Bebenhausen, Württemberg, should belong to *Oxytoma scanica*, seems rather doubtful.

2. The Brandsberga pebbles have been traced to their bedrock which forms an irregular sheet of sandstone upon the Archean, only a few metres thick, entirely hidden by Glacial drift, and with an area of about 0,06 of a square mile.

## Brandsberga-blockens ålder

Indelningen av lagerföljden i lias är som bekant helt grundad på ammoniterna. I områden utan dessa ledfossil måste man försöka utnyttja andra djurlämningar eller växter. Detta har med växlande framgång försökts i Skåne, där ammoniterna förekomma sporadiskt och alltså saknas i stora delar av lagerföljden. Sålunda har NATHORST uppställt sju växtzoner för rät och lias, och LUNDGREN har kompletterat schemat med lika många skal-»bankar».

NV Skånes rät-lias har på detta sätt kommit att ståta med en indelning, som i detaljrikedom vida överträffar vad man lyckats uppnå på basis av ammoniterna i övriga Europa. Schemat består av åtta rätiska och sex liassiska zoner eller bankar. Sedermera har det visat sig att endast de tre understa växtnivåerna, som numera sammanfattas i *Lepidopteris*-zonen, tillhöra rät, medan de övriga elva räknas till lias. Av dessa äro fyra växthorisonter, som ligga i allra understa delen och samtliga ingå i höörfloran. De tillhöra *Thaumatopteris*-zonen i modern bemärkelse. De fyra undre molluskbäddarna (*Mytilus*-, *Cardinia*-, *Cyclas nathorsti*- och *Pullastra*-bankarna) motsvara höörsandstenen i rätliasbildningarnas uttunning i centrala Skåne. Alla dessa åtta nivåer i NV Skåne (resp. två i Ringsjöområdet) ha sammanfattats som undre hälsingborgslagren (Troedsson) och torde motsvara den äldsta ammonitzonen i Mellan- och Västeuropa, d. v. s. planorbiszonen eller lias $\alpha_1$.

Om närmast följande ammonitzon, angulatumzonen, lias $\alpha_2$, är representerad i Skåne, skulle det vara genom ostreabanken, som ligger överst i de övre hälsingborgslagren men ej på något sätt skiljer sig faunistiskt från de undre hälsingborgslagren, och möjligen även genom nästa nivå, aviculabanken, som antingen tillhör $\alpha_2$ eller $\alpha_3$. Till $\alpha_3$ hör utan tvekan ammonitbanken, som ligger överst i den nämnda liasserien och hyser en fauna med välkända europeiska ledfossil såsom *Coroniceras*-arter och *Gryphaea arcuata.*

En ännu yngre liasfauna träffades vid ett större dikningsarbete i Katslösa S om Hälsingborg för några år sedan. Samma fauna beskrevs från Fyledalen för snart 70 år sedan av Moberg och är även känd från Bornholm. Genom ammonitfynd i SÖ Skåne kan den inrangeras i lias $\gamma$, men på Bornholm och möjligen även i Skåne fortsätter serien upp i lias $\delta$, som tycks utgöra slutstadiet i de skandinaviska liasbildningarna. Till dessa yngsta liasbildningar, $\gamma$ eller $\delta$, hör sandstenen vid (Brandsberga och) Kolleberga.

Under fältarbetet för geologiska kartbladet Trolleholm påträffade S. A. Tullberg (1880) i trakten S. om Ljungbyhed talrika block av lias-sandsten med en rik fauna av marina mollusker, bland vilka Bernhard Lundgren (1881) kunde urskilja närmare ett 20-tal arter. Faunan var påfallande genom sin frodighet, jämfört med andra skånska lias-faunor. Sandstenen och faunan äro uppkallade efter den närbelägna byn Brandsberga, som i den äldre litteraturen anges som fyndort. I själva verket äro de stora blocksamlingarna och mest givande fossillokalerna helt inskränkta till Kolleberga kronoegendom, något som även tydligt framgår av de lokalbeskrivningar som lämnats av Tullberg (l. c.) och Nathorst (1885).

I sitt meddelande om blockfyndet anslöt sig Tullberg till Nathorsts uppfattning (1880) att höörsandstenen avlagrats i en vik som sträckte sig längs nordöstra sidan av Söderåsen och som norr om åsen stod i förbindelse med kolbäckenet. Den tydligt marina Brandsbergafaunan »närmast mynningen af viken» övergår mot sydost i en allt fattigare fauna som till en början kan innehålla rikligt med *Gardinia follini* men »innerst i den ursprungliga viken, i trakten kring Hör, hafva växtlemningar i mängd blifvit inbäddade i sandstenen, endast några få musslor hafva här träffats».

Samma åsikt utvecklade Nathorst vidare i kartbladsbeskrivningen (1885), medan Lundgren (1881) först understryker den paleontologiska olikheten mellan å ena sidan Brandsbergablocken och å den andra slipsandstenen vid Hälsingborg och höörsandstenen, båda med *Cardinia follini*, och sedan tillägger: »Rättast torde måhända förhållandet förklaras sålunda, att varieteten . . . med *Cardinia follini* är afsatt i en vik närmare kusten eller i bräckvatten (ja kanske till och med i sött) under det att [Brandsberga] varieteterna . . . äro motsvarande marina bildningar, för vilka Gellaberg tyckes vara östligaste fyndorten.» Emellertid har LUNDGREN i sin tabell (l. c. sid. 20) placerat Brandsberga-sandstenen i en högre stratigrafisk nivå än sandstenen med *Cardinia follini* — dock med frågetecken. Från denna vacklande ståndpunkt kapitulerar han i sitt nästa arbete (1888) helt för NATHORST men fortfarande i mycket oklara vändningar: ». . . så torde väl förhållandena enl. NATHORST bäst uppfattas sålunda, att vid den tid, som ung. motsvarar Cardinia Lias, Aviculabanken i Helsingborgstrakten, en transgression af hafvet betydligt längre åt Ö. egt rum, hvarunder marin Hörssandsten afsattes, under det att den limniska Hörssandstenen med landtväxter ung. samtidigt bildades . . .». Denna anpassning tvingar honom emellertid att bortse från eller bagatellisera sådana fakta som att *Cardinia follini* i hälsingborgsområdet uppträder inom en enda väl begränsad nivå, långt nedanför aviculabanken, eller att aviculabanken, trots sin ganska rika fauna, visar praktiskt taget ingen faunistisk likhet med Brandsberga-sandstenen.

Man kunde tycka, att det för LUNDGREN skulle ha varit ganska enkelt att med de fakta han förfogade över taga ståndpunkt i denna fråga.

Saken är dock mera komplicerad än så. För det första får man komma ihåg, att stratigrafien i lias helt bygger på ammoniterna, för det andra att övriga mollusker i allmänhet ha en rätt stor vertikal utbredning och därför knappast ägna sig som ledfossil, och slutligen är den molluskfauna som uppträder i NV Skåne synnerligen artfattig, sporadisk och lokal med få anknytningar till den samtidiga högmarina faunan i Mellan- och Västeuropa. Lundgrens osäkerhet bottnade i att materialet var otillräckligt och ej tillät några säkra slutsatser.

Under de 70 år som gått sedan dessa problem diskuterades av NATHORST och LUNDGREN har emellertid ett och annat tillkommit, som kan vara ägnat att kasta nytt ljus över problemet.

Se vi på Brandsberga-faunan i dess helhet, så finna vi att av dess nära 20 arter ingen enda återfinnes vare sig i Hälsingborgs-etagen ($\alpha_1 - \alpha_2$) eller i Döshult-etagen ($\alpha_3 - \beta$). Med Katslösa-faunan (lias $\gamma$) har den följande arter gemensamma: *Trigonia primæva?* TROEDSSON, *Plagiostoma succincta* (SCHOTHEIM), *Oxytoma inaeqvivalvis* (SOWERBY), *Chlamys tullbergi* (LUNDGREN), *C. textoria* (SCHLOTHEIM) och *Plicatula suecica*(?), LUNDGREN, varjämte belemniter och articulata brachiopoder utgöra ett betydelsefullt högmarint inslag. Härtill kommer

*Oxytoma scanica* (Lundgren), som även träffats i SÖ Skåne. Brachiopoderna inkomma i NV Skåne med de första ammoniterna, alltså i ammonitbanken ($\alpha_3$) och äro ganska allmänna vid Brandsberga och Katslösa ($\gamma$) men tyckas ej ha nått SÖ Skåne ens i $\gamma$-tid. Ett mycket osäkert belemnitfynd i ammonitbanken ($\alpha_3$) omtalas av Lundgren. Säkra exemplar ha träffats vid Brandsberga och i SÖ Skåne ($\gamma$) och en hel belemnitfauna vid Katslösa ($\gamma$). På grund av belemnitinslaget kan Brandsberga-faunan ej vara äldre än lias $\gamma$.

Av de mollusker som Lundgren beskrivit från Brandsberga-blocken är det två arter som förtjäna särskild uppmärksamhet, nämligen *Trigonia* sp. och *Oxytoma scanica*.

*Trigonia* är ett mollusksläkte som för första gången visar sig i understa lias i Sydamerika och i Spanien, spelar en utomordentlig roll i jura och krita och numera för en tillbakadragen tillvaro i Ostindiska arkipelagen. De tidigaste representanterna finner man i Spaniens angulatumzon ($\alpha_2$), medan släktet tycks ha nått England först vid övergången mellan lias $\beta$ och $\gamma$ — och Sverige troligen ännu senare(?).

Två exemplar ha träffats i lösa block av brandsbergatyp inom det område, där dessa block uppträda, det ena inom det blockrika området vid Kolleberga. De äro dåligt bevarade men kunna sannolikt ej till arten skiljas från *Trigonia primaeva* Troedsson, en art som träffats i flera exemplar i lias $\gamma$ vid Katslösa och i Fyledalen. Brandsberga-exemplaren äro anmärkningsvärda genom sin storlek, men denna egenskap dela de med hela Brandsberga-faunan i övrigt, som i detta fall är av mera »europeisk» typ än de småväxta molluskfaunor som eljest karakterisera Skånes lias.

Förekomsten av *Trigonia* måste anses som ett avgörande indicium för att Brandsberga-sandstenen är yngre än Höör-sandstenen.

*Oxytoma scanica* är ganska allmän i Brandsberga-sandstenen. Den tillhör en inom släktet egenartad grupp, som karakteriseras av ett fåtal ribbor och är företrädd av flera arter, spridda i undre och mellersta lias. Hos de äldsta formerna, såsom *O. longicostata* (Stutchbury) i Pre-planorbis beds och tidiga former av *O. cygnipes* (Young and Bird), äro ribborna försedda med taggar och skjuta långt utanför brämet samt variera i antal från fyra till sju, varjämte mellanliggande bräm har rak kant och raka tillväxtlinjer. Högre upp i lias bli ribborna släta, ej utskjutande, samt till antalet 5; bräm och tillväxtlinjerna mellan ribborna konkava. I sin extrema form — som är utbildad hos de franska representanterna för *O. cygnipes* i lias $\delta$ och hos *O. scanica* vid Brandsberga — likna dessa musslor ett uppspänt halvt paraply, vars spröt motsvara ribborna.

*Avicula anserina* Moberg från SÖ Skåne visar sådana likheter med

*Oxytoma scanica* att den sannolikt ej kan skiljas från denna art. Tyvärr har originalet gått förlorat. Arten beskrevs av Moberg tillsammans med den övriga liasfaunan i SÖ Skåne, som tillhör lias $\gamma$, men har aldrig träffats tillsammans med denna utan i en sandstensboll i kritkonglomeratet vid Rödmölla nära Tosterup. Något fossil av denna typ har heller aldrig träffats i den rika $\gamma$-fyndorten vid Katslösa. Detta kan tyda på att *Oxytoma scanica* tillhör en högre nivå än lias $\gamma$.

Av viss betydelse för åldersbestämningen är även det faktum att det artrika *Cardinia*-släktet helt saknas i Brandsberga-sandstenen. Dess vertikala utbredning sammanfaller med undre lias ($\alpha$ och $\beta$).

Sammanfattar vi det nu sagda så ange *Trigonia*-arterna en nivå som icke kan ligga nedanför lias $\gamma$, medan *Oxytoma scanica* kommer närmare lias $\delta$.

I strid med den nu givna tolkningen står emellertid ett fynd, som nyligen beskrivits från Sydtyskland, förutsatt att det är riktigt bestämt. I planorbiszonen ($\alpha_1$) vid Bebenhausen i Württemberg har träffats en stenkärna av en stor glesribbad *Oxytoma*, som av H. Hölder (1953) identifieras med *O. scanica* (Lundgren). Exemplaret, som förf. hade tillfälle att se vid ett besök i Tübingen sistlidna sommar, är ofullständigt i fråga om den yttre begränsningen och visar endast avtryck från skalets insida samt saknar varje spår av tillväxtlinjer. I avtrycket från insidan äro givetvis ribborna släta. Deras verkliga utseende och längd kan ej avgöras. Däremot har det tyska exemplaret sex ribbor och dessutom ett par sekundärribbor, vilket visar en variationsförmåga beträffande ribbtalet som helt saknas hos de talrika brandsbergaexemplaren. Även om en sådan variation i ribbantal — som Hölder påpekar — ej är artskiljamde, kan man ej bortse ifrån ovan nämnda utvecklingstendens, som placerar den württembergska och den skånska formen på olika nivåer i lagerföljden.

### Fast anstående Brandsberga-sandsten

På geologiska kartbladet Trolleholm ha tvenne områden för brandsbergablock markerats. Det ena ligger strax öster om det ställe där en bäck korsar gamla landsvägen strax N om Brandsberga by. Det andra ligger nära 2 km åt SO. från det förra, båda inom Kolleberga kronoegendom. Ett tredje blockområde, från vilket förf. gjort betydande insamlingar, befinner sig emellan dessa båda, i södra delen av Kolleberga by. F. ö. uppträda block mera glest i trakten mellan dessa koncentrationer och landsvägen vid Brandsberga. Redan Nathorst (1885) antar att blockanhopningarna tyda på att bergarten anstår eller varit anstående i närheten.

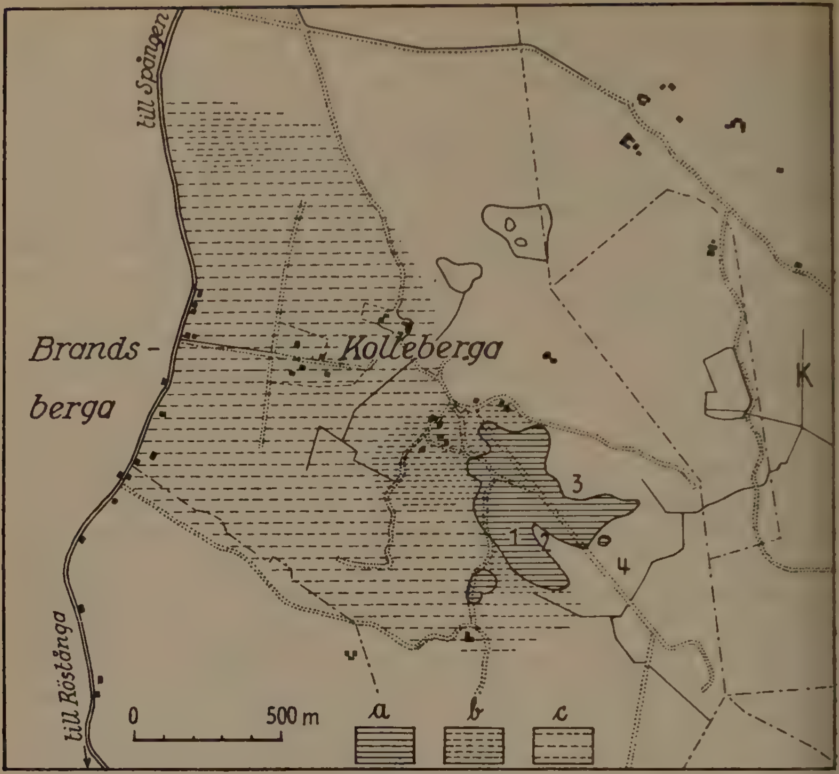

Fig. 1. Utbredningen av Brandsberga-sandstenen. a fast anstående, b riklig blockförekomst, c gles blockspridning. K kaolin. 1—4 försöksgropar (se texten).
(The distribution of the Brandsberga sandstone. a bedrock, b and c drift pebbles, more or less concentrated. K kaolin in situ. 1—4 diggings.)
För publicering godkänd i rikets allmänna kartverk den 11 november 1954.

För att få större klarhet häri föreslog jag för några år sedan amanuens SVEN ASKER att göra en närmare undersökning i terrängen. Med understöd från Lunds geologiska fältklubb och Paleontologiska institutionen sattes ASKER sommaren 1952 i stånd att rekognoscera blockspridningen och företaga grävningar efter fast klyft. Förutsättningarna voro följande.

Det rikligt förekommande isälvsgruset i dessa trakter visar, att isen i slutstadiet visserligen rört sig från Smålandsgränsen mot SV, men att den hejdats inför den 150 m höga Söderåsen. Här har den släppt fram sitt smältvatten i riktning mot Skälderviken, alltså emot VNV, parallellt med Söderåsen. Ett stråk med isälvsgrus löper från Färingtofta över Allarp mot Ljungbyheds grus- och sanddelta, längs sydgränsen för brandsbergablocken och med en riktning som svänger från västlig ill västnordvästlig. Då det kunde antagas, att isrörelsen gått i samma iktning och att ändringen av rörelseriktningen i isens slutskede gynnat n lösbrytning av sandstenen från dess underlag, så borde den fasta lyften finnas åt öster eller sydöst, räknat från blockområdena. Urberg år i dagen strax söder om det sydligaste blockområdet och har träffats irekt under morän i en brunn i Kolleberga by. Emellan dessa båda unkter höjer sig inom kronoparken en låg platå med tämligen branta à 10 m höga sluttningar runt om, och sankmarker nedanför dessa. tarka skäl talade för att sandstenen var anstående här. Det är nämgen på samma sätt som Höör-sandstenens erosionsrester uppträda i rakten norr om Ringsjön. Liksom därvarande platåer omges denna v kärrmarker, beroende på den dåliga dräneringen på den kaolinittrade gnejsen, medan platåytan är torr. Med den antagna isrörelsen slutskedet får man även en förklaring till att blocken upphöra i väster id landsvägen: Denna följer i stort sett gränsen för Ljungbyhedsdeltats englaciala sediment, under vilka den fortsatta blockspridningen åt V blivit begravd.

Sandstenen går ingenstädes i dagen.

Enligt planen lät Asker utföra grävningar i platån. Det blev inalles re. Alla nådde en bottenmorän av sandsten vid 1 à 1,5 m djup. I denna ade ytterligare försök gjorts att nå fast klyft men utan framgång. den djupaste, 2 m, fanns i bottnen endast sandsten i större eller indre stycken, nästan utan mellanmassa; en plan yta kunde vara fast.

Dessutom grävdes på flera ställen inom det mellersta blockområet, som består av lågt liggande åkrar i bruten terräng. Här stötte an överallt på urbergsmorän med stora stenar.

Innevarande hösttermins fältkurs i geologi förlades till Kolleberga ed närmaste uppgift att kartera platån. Dessutom fick två grupper nder en halvdag göra grävningar.

Platån har en areal av 15 ha och skiljes, som sagt, i regel från omvande mera orolig urbergsterräng genom mossar och stråk av sankarker. Tre grävningar utfördes, en (1) på platån, i södra delen (Askers rävningar hade utförts i norra delen), en (2) i bottnen på en sänka, m från SO intränger i platån, samt en (3) i sankmarken utanför nordstra gränsen. Dessutom studerades en 2 m djup försöksgrop, som av kogsskolan upptagits i en kulle söder om platåns sydöstra arm (4).

Vid 1 nåddes den hårda sandstensbottenmoränen. Varken verktyg, after eller tid räckte till att tränga igenom denna.

Vid 2 genomgrävdes 0,5 m torv och 1 m sand, varefter grundvattnet ndrade nedträngandet.

Vid 3 träffades endast urbergsmorän och detsamma var förhållandet ed den fjärde observationspunkten.

Den karterade platån torde i stort sett bestå av Brandsberga-sandsten i kontakt med kaolinvittrat urberg. Det är naturligtvis ej uteslute att andra sandstensrester finnas i trakten, t. ex. i anslutning till de nordliga blockområdet. Österut från Kolleberga finns en rad kaolinförekomster, alltifrån granngården Vessmanstorp till Ljung, Foresta och Färingtofta, alla vittnande om ett länge kvarliggande sedimenttäcke.

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# Revue annuelle de la littérature géologique suédoise 1953

Rédigée par

R. Sandegren

Pour rendre la littérature géologique suédoise plus accessible, la Société éologique de Stockholm publie depuis l'an 1927 des revues annuelles de ré- ımés en allemand, en anglais ou en français de cette littérature. Les revues ont insérées annuellement dans le IVième numéro de »Geologiska Föreningens Stockholm Förhandlingar» et ont pour but de constituer des bibliographies omplètes de la littérature géologique suédoise.

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## Géologie régionale

**Behrens, Sven E:** Morfometriska, morfogenetiska och tektoniska studie av de nordvästskånska urbergsåsarna, särskilt Kullaberg (Morphometrische morphogenetische und tektonische Studien der nordwest-schonischen Urgebirgsrücken, mit besonderer Berücksichtigung von Kullaberg). — Medd. fr Lunds Univ. Geogr. Inst. Avhandl. XXIV, 254 pp., 91 text-figs., 10 plates Deutsche Zusammenfassung pp. 245—254. Lund 1953. — Um das Problem Inwieweit die topographische Formgebung durch die Eigenschaften de geologischen Körper bestimmt wird, zu lösen, hat der Verfasser in seine Dissertation morphologische, petrographische, gefügekundliche und tektonische Daten koordiniert.

Der erste, morphographische Teil wird u. a. mit Höhenkarten, Querprofile und Reliefenergiekarten beleuchtet. Im zweiten morphogenetischen Te wird die Bedeutung der petrographischen Inhomogenitäten behandelt. Di konformen Kontakte zwischen Amphibolit und Gneis bieten günstige Angriffspunkte für die Erosion während die postsilurischen Ganggesteine (Diabas Diabasporphyrit und Kullait) keine bedeutende Rolle für die Topographi spielen. Nach Methoden der Sander'schen Schule werden die Zusammenhäng zwischen Topographie und Gefüge dargestellt. Viele topographische Züg sind auf das Flächengefüge und dessen Variation zurückzuführen. Die morphogenetische Bedeutung der Klufttektonik wird eingehend behandelt Im dritten tektogenetischen Teil wird angedeutet, dass Nordwestschonen eine rotationellen Deformation ausgesetzt war, deren nördlicher Vektor gegen Os und deren südlicher gegen West gerichtet war. Die grosse Verwerfungslini durch Schonen hätte sich in variskischer Zeit gebildet. H. Tullström

**Behrens, Sven E:** Morphometrische, morphogenetische und tektonisch Studien der nordwest-schonischen Urgebirgsrücken, mit besonderer Berücksichtigung von Kullaberg. — Lund Studies in Geography. Ser. A. Physical Geography No. 5, 1953, 34 pp., 28 text-figs., 4 plates. — Dieser Buch enthält die Zusammenfassung in Deutsch der grösseren oben referierte Dissertation. H. Tullström

***von Eckermann, Harry:** Geologisk historia (Geological history). — En bo om Mälarlandskapen, bygd och näringar genom tiderna utg. av Mälarprovinsernas Hypoteksfören. i anl. av dess 100-årsjubileum. pp. 14—48, 9 text-figs. Sthlm 1953.

**Ekström, Gunnar:** Beskrivning till kartbladet Lund (Explanation to th [agrogeological] map-sheet Lund). — S. G. U. Ser. Ad. N:o 2. 102 pp., 13 text-figs., 3 plates. Sthlm 1953. — This map is number two in the series of th agrogeological maps on the scale 1: 20 000 of which an explanation is give in this review for 1947, p. 552 (Explanation to the map-sheet Hardeberga). G. Ekström

**Ekström, G.:** Ångermanlands och Medelpads geologi (Geology of Ångermanland and Medelpad). — Natur i Ångermanland och Medelpad. pp. 16—31 11 text-figs. Uppsala 1953. — A popular account of the geological history o two provinces in Northern Sweden. G. Ekström

**Frödin, John:** En studieresa till Chile 1951—1952 (A journey in Chile fo purposes of study 1951—1952). — Uppsala, K. Vetenskaps-Societetens Årsbok 1953, pp. 29—101, 20 text-figs., 1 plate. Also as: Medd. fr. Uppsala Univ Geogr. Inst. Ser. A. N:o 92.

**Hjelmqvist, S. och Lundqvist, G.:** Beskrivning till kartbladet Säter (Explana-
on to the map-sheet Säter). — S. G. U. Ser. Aa. N:o 194, 97 pp., 37 text-figs.,
maps in scale 1: 50 000 and 1: 100 000 (solid rock) Sthlm 1953. — The map
printed in 47 designations and symbols. The map and the explanation
nnect to the adjacent map-sheets, Smedjebacken, Hedemora, and Falun.
he bedrock mostly consists of granites and leptite. It is given a very peculiar
naracter by a lot of deleritic dykes in SW—NE. In the southwestern part of
ne map the direction of the dykes is NW—SE. They are of sub-Jotnian age.
any dykes of sub-Jotnian quartz porphyry also occur.

The Quaternary geology is already known mainly from the adjacent di-
ricts. Late Glacial drainage channels are of great interest. They constitute
e firm points for the study of the highest marine limit which here lies about
95—199 m above the present sea-level. The western part of the great plain
' Stora Tuna has been ice-dammed. Therefore in the western part of the
strict the highest shore line lies 205 m above sea-level. G. Lundqvist

**Kautsky, G.:** Der geologische Bau des Sulitelma—Salojaure- Gebietes in den
ordskandinavischen Kaledoniden. — S. G. U. Ser. C. N:o 528 [= Årsb.
6 (1952) N:o 4] 232 S., 91 Textfig., 10 Tafeln. English summary S. 219—228.
iss. Sthlm 1953. — Im Kartengebiet sind zwei grosstektonische Einheiten
orhanden, von denen jede in mehrere Decken gegliedert wird. Die untere
inheit (Akkajaurekomplex) besteht aus dem östlichen Kratogen zugehö-
gen präkambrischen Graniten und Gneisen, mit einer dünnen Auflage
on eokambrischen und kambrischen Quarziten und Schiefern. Diese Se-
mente sind ausserhalb der Geosynklinale abgelagert worden. Durch die
indestens 250 km lange Überschiebung der grossen Sevedecke in südöst-
cher Richtung wurde der Akkajaurekomplex aufgesplittert und in den
aledonischen Deckenbau miteinbezogen.

Nach Abschluss des eigentlichen Deckenbaues wurden Sevedecke +
kkajaurekomplex an der norwegischen Grenze und westlich davon plastisch
faltet. Bei starker Umkristallisation und palingenen Prozessen bildeten
ch grosse Längs- und Querantiklinalen mit Ausbildung von sogenannten
nantled domes», in deren zentralen Teilen auch das kaledonisch deformierte
nd veränderte Grundgebirge des östlichen Kratogens (Tysfjordgranit)
ufgeschlossen ist. Diese plastische Faltung hat eine deutliche Vergenz gegen
ordwesten, wobei es teilweise in dieser Richtung (entgegengesetzt der
chtung des kaledonischen Deckenbaues) zur Ausbildung von liegenden
alten kommt. Die Sulfiderze des Sulitelmagebietes, die teilweise in alten
berschiebungsflächen liegen, werden mit diesem Geschehen in zeitlichen
usammenhang gebracht.

Die grosse Sevedecke enthält die kaledonischen Geosynklinalsedimente.
e wird in 4 Teildecken (Pieskedecke, Vastendecke, Salodecke und Gasak-
cke) gegliedert, die sich durch den Metamorphosgrad ihrer Gesteine, die
esteinsparagenese und den tektonischen Stil deutlich unterscheiden. Die
ecken bestehen aus präkambrischen Granitresten mit aufgelagerten Sedi-
enten von eokambrischem bis oberordovizischen Alter. In den niedrig me-
morphen Phylliten der Pieskedecke wurden mehrere Fossilfunde gemacht.
fusive und intrusive Grünsteine sind reichlich vorhanden.

Die Stratigraphie, Tektonik und metamorphe Geschichte der einzelnen
ecken wird beschrieben. U. a. konnte eine tektonische Phase mit Faltung

und Überschiebungen vor der Etage 4 c des Oslogebietes (Eknephase) nach gewiesen werden, die mit der takonischen Faltung in Nordamerika korrelier wird. G. Kautsky

**Kulling, O.:** Fjällkedjans berggrund (Bedrock of the Caledonian mountai range). — Atlas över Sverige. 7—8, p. 5, 1 text-fig. English summary p. 7 Sthlm 1953. — The Swedish part of the Caledonian mountain range is almos entirely characterized by overthrust masses. In a brief survey of the mountai bedrock the author deals with its principal units and its historical development, and divides the bedrock in the following groups, viz. the sparagmit series, the tillites and varved shales of the Varanger Ice Age, the Strön quartzite series, the fossiliferous Eastern Cambro-Silurian, the Wester Cambro-Silurian, and the more altered mountain schists. O. Kulling

**Lundegårdh, P. H. och Sandegren, R.:** Beskrivning till kartbladet Sär (Explanation to the map-sheet Särö). — S. G. U. Ser. Aa N:o 195. 106 pp. 46 text-figs., 2 maps. Sthlm 1953. — The geological map-sheet Särö comprise the Mölndal—Styrsö—Vallda region immediately south of Gothenburg. A an introduction to the geological text (in Swedish) accompanying the ma sheet, a general survey of landscape and population is given. Part I of th geological text, the bed rock, can be considered as a summary of a more extensive bulletin in English: »Petrology of the Mölndal—Styrsö—Valld region in the vicinity of Gothenburg», see this Revue p. 629.

Among the Quaternary deposits moraine (drumlins and terminal morain ridges), glaci-fluvial oses and marginal deltas, marine Late Glacial and Pos Glacial sediments (clay, sand, and gravel), and Post Glacial peat deposit occur. Glacial striae, »roches moutonnées», and pot-holes are common When the ice melted away the whole area, except only some rather smal territories, was inundated by the sea. The highest Late Glacial marine limi lies 91 m in the northern and 83 m above the present sea-level in the souther part of the map-sheet. Owing to the upheaval of land a regression began but this regression was interrupted by a transgression during the stone age Thus the shore about 4 500 B. C. was lying about 20 m above the presen sea-level. Afterwards regression again went on until our days. During thes changes of level marine abrasion has been very intensive, and therefore th bed rock to great extent is free from Quaternary deposits. The marine faun in the clays and shell beds is listed. The different stages of the changes c level, and of the immigration of the vegetation into the area in Post Glacia times are dated by aid of pollen-analytical investigations of sediments an peat deposits (8 pollen-diagrams).

P. H. Lundegårdh and R. Sandegren

**Lundqvist, G.:** Jordarterna (Quaternary deposits). — Atlas över Sverig Geologi 15—16 pp. 1—8, 4 text-figs., 1 map (scale 1: 200 000 with 8 designa tions and symbols) English summary pp. 7—8. Sthlm 1953. — A brief de scription of the Quaternary deposits in Sweden and of their types, particularl in regional respect. A text-figure shows Sweden divided according to th frequency of different soils and outcrops. G. Lundqvist

**Lundqvist, G.:** Sjö (Lake). — Svensk Uppslagsbok. 2 uppl. Bd 26 spa 21—28, Malmö 1953.

**Magnusson, N. H.:** Dalslands geologiska historia (Geological history of Dals-
nd). — Natur i Dalsland, pp. 13—27, 8 text-figs. Uppsala 1953. — In pop-
lar form, the author interprets the geological history of Dalsland, a western
wedish county situated between Lake Vänern and Norway. Among the
umerous and variable rocks of Dalsland, there are three well defined series
f sediments and volcanics, *viz.* The Åmål, Kappebo, and Dal series, all
elonging to the Archaean.

P. H. Lundegårdh

**Marklund, Nils:** A study in a Caledonian mayor thrust plane. — Bull. Geol.
nst. Upsala, Vol. XXXIV, 1949—1953, pp. 205—221, 10 text-figs., 2 plates.
– Through motions between the Autochtonous and the Yraf Complex in
lation to each other nappes of a lower order have developed in the inter-
pace. These motions would possibly also allow an explanation of the problem
f the Seve metamorphism. The entire frictional energy has been set free
ithin a narrow zone. In this way the confusing picture of different grades of
etamorphism in the great Seve Thrust Sheet (of which the Yraf Complex
a part) can be explained.

From the author's concluding remarks.

**Nelson, Helge:** Skåne, övergångsområdet. Gränszoner och regioner (Scania,
transitional province. Boundary — zones and regions). — København,
eografisk Tidsskrift, Bd. 52, 1952—53, pp. 201—221, 10 text-figs. — In
popular manner the author presents Scania as a transitional region between
liddle Europe and Fennoscandia both geologically and geographically. The
ich vegetation of Scania is put in connection with the Quaternary geology
nd is *i. a.* illustrated by maps of cultivation of wheat and oleiferous plants.
eological boundary lines are drawn in these maps. The thickness of the
canian Quaternary strata is described at the end of the paper.

H. Tullström

**Quensel, Percy:** Nuevos comentarios sobre la geologia de las Islas de Juan
ernandez. — Facult. de cienc. ficic. y matem. Univ. de Chile. Inst. de Geolo-
ia. Publ. N:o 2. 35 pp. 32 figs. Santiago de Chile 1953.

**Svanholm, John W.:** Kors och tvärs över Filippinerna (The Philippines
ngthwise and crosswise). — Sthlm, G. F. F. Bd 75, 1953, pp. 309—312.

**Thorsteinsson, Asgeir:** Forskningsproblemer i Island (Research problems in
eland). — Sthlm, I V A, Årg. 24, 1953, pp. 303—311, 3 text-figs.

## Géologie générale et dynamique

**Behrens, Sven E.:** Metodisk nyorientering inom geomorfologin (Methodical
orientation in geomorphology). — Lund, Svensk Geogr. Årsb. Årg. 29,
953, pp. 153—179, 15 text-figs., 1 plate. English summary pp. 176—179. —
he time of intuitive estimations in geomorphology has passed and has firstly
be replaced by measurements of geomorphological data in order to repro-
uce them numerically. Secondly a tendency to explain geomorphogenesis by
nalysis of the factors associated with the material has been evolved. In the
uthor's investigations of the three Archaean ridges of northwestern Scania
e factors analysed were: petrographical variations, petrofabric formations
efüge) and tectonic conditions. Thirdly the geomorphologist often has to

solve his problems by application of pure geological methods. He has to take into account questions relating to structural geology, tectogenetic and orogenetic matters. H. Tullström

***Båth, Markus:** Jordbävningar i Fennoskandia (Earth quakes in Fennoscandia). — Sthlm, Populär Astronom. Tidskr. 1953, pp. 19—33, 9 text-figs.

**Båth, M.:** Seismicity of Fennoscandia and related problems. — Leipzig Gerlands Beitr. z. Geophys. 63, pp. 173—208, 12 text-figs. Köthen 1953. Also as Meteorolog. Inst. Uppsala Medd. N:o 34. — A study of the seismicity of Fennoscandia by means of macroseismic observations during the year 1891—1930. Instrumental records of these earthquakes exist only in exceptional cases. The following matters have been specially calculated and studied depths of hypocentres; number, energy, and geographical distribution o earthquakes; time variations of seismic activity (diurnal, annual, long-period relation of earthquakes to other geophysical phenomena, notably the lan uplift in Fennoscandia. It has been shown that the strain energy accumulated by the land uplift is equal to the energy released in earthquakes. The application of modern methods, especially those developed by Gutenberg, Richte and Benioff at the Seismological Laboratory in Pasadena, has made it possibl to deepen our knowledge at the same time as it entails a re-evaluation o earlier statistics. From the author's summary.

**Båth, Markus:** Comparison of microseisms in Greenland, Iceland, an Scandinavia. — Sthlm, Tellus, Vol. 5, 1953, pp. 109—134, 11 text-figs. — Microseismic amplitudes and periods recorded at Scoresby-Sund, Reykjavik Bergen, and Uppsala in seven different cases from the years 1949—1950 ar studied. At all stations the polar air is of essential importance for the generation of microseims, whereas there is in general no close connection with th cyclone centres themselves, A coast effect is of importance for Scandinavia whereas the source for microseims recorded at Scoresby-Sund is located ove the open ocean within the polar air. Standing ocean waves may be of importanc at the Norwegian coast but in many cases not on the open ocean. Th microseismic waves propagate much farther over the continent than alon the ocean bottom. The microseismic periods in Scandinavia vary generall in parallelism with the amplitudes, in Iceland and Greenland generally not Period minima and rapid amplitude increases are observed in Scandinavi when cold fronts cross the Norwegian coast. There is no sign of microseismi barriers in the Atlantic outside Scandinavia. The microseims at Scoresby Sund have a regular, group character; at the other stations they are generall continous. Author's abstract

**Båth, Markus:** Observations séismographiques de l'Observatoire géophysiqu de Kiruna de janvier à décembre 1952. — Uppsala, 174 pp. Lund 1953.

**Du Rietz, Torsten:** Composition of beach sand along the Swedish Eas Coast. — Sthlm, G. F. F. Bd 75, 1953, pp. 381—395, 11 text-figs. — San samples have been analyzed chemically and the mineralogical compositio determined. The sand reflects the average composition of the bedrock of th regions sampled, with a slight increase in quartz content. The roundnes of the sand particles is mainly a function of the exposition to wave actio and of quartz content, the quartz being most easily rounded.

Jan Lundqvist

**Jerlov, N. G.:** Influence of suspended and dissolved matter on the trans- arency of sea water. — Sthlm Tellus, Vol. 5, 1953, pp. 59—65, 9 text-figs. — he transparency at different levels in the sea as recorded by means of a ransparency-meter is compared with the distribution of suspended particles tudied with the aid of a Tyndall-meter. A simple procedure is used to dis- inguish between different components of light extinction and to derive alues of the content of the dissolved yellow substance. The distribution of ellow substance is illustrated for the transition area between the Baltic and he Skagerrak and for the outflow of the Göta älv. It is emphasized that the ontent of yellow substance may often be considered as a characteristic pro- erty of a water mass.

Author's abstract

**Jerlov, N. G.:** Particle distribution in the Ocean. — Reports of the Swedish eep Sea Expedition, 3, 73; Appendix, Table I.

**Jerlov, N. G.** and **Kullenberg, B.:** The Tyndall effect of uniform minerogenic uspensions. — Sthlm, Tellus, Vol. 5, 1953, pp. 306—307, 2 text-figs.

**Lundqvist, G.:** Tillägg till palsfrågan (Addenda concerning the palses). — thlm, G. F. F. Bd 75. 1953, pp. 149—154, 3 text-figs. English abstract p. 49. — The author completes his earlier examinations of palses with some bservations. On the palses, boulders are sometimes found. Pieces of moraine nd sand have also been observed. Some boulders have possibly been trans- orted to the palses by laps, but there are also examples of boulders which ust have been raised on the palse from its foundation by the frost heaving. n some palses there are found boulders of moraine, »moraine cakes», that robably have been heaved by the frost at the beginning of the process. he author discusses the »Gährlehmpalsen» of Fries, and is of the opinion hat they have been developed in the same way as the peat-palses. Both re products of physical processes. The same is the case of a little boulder- alse which was found by the author in 1950. Consequently there are three inds of palses: peat-palses, loam-palses, and boulder-palses.

Author's abstract

**Magnusson, Nils H.:** Bergtryck och bergstyrka (Studies of stresses and sta- ility in rocks). IVA, Medd. FKO nr 14, 1953, 6 pp. — In Sweden, a committee as studied the problems of stresses, stability, and deformations of rocks since 941. The work has been concentrated to mines. Joints, faults, and zones of chistosity have been mapped. Later, a nickel cell constructed by prof. N. Hast has been used for measurements of stresses in the interior of rock bodies n mines).

·P. H. Lundegårdh

**Magnusson, N. H.:** The formation of reaction skarn in iron ores of Central weden. — Proc. Intern. Symp. on the reactivity of solids, Gothenburg 1952, p. 427—430. Göteborg 1953. — The author gives a brief survey of the rincipal kinds of skarn in Central Sweden. Original deposits most probably omposed of hematite or limonite have altered to magnetite and hematite res. Simultaneously with deep-foldings of the bed-rock and formation of ranites reaction skarn frequently developed around the ore bodies.

P. H. Lundegårdh

**Milthers, V.:** Lidt fornøden »historik» for laesere af T. Troedssons opsats om »blockfrekvenser» (A historical account, necessary for the reader of the paper by T. Troedsson on »boulder frequencies»). — Sthlm, G. F. F. Bd 75, 1953, pp. 113—115.

**Rasmusson, Gunnar:** Karstfenomen vid Torneträsk. Preliminärt meddelande. (Karst phenomena at Lake Torneträsk. Preliminary report.) — Lund, Svensk Geogr. Årsb. Årg. 29, 1953 pp. 215—218, 2 text-figs. — The most important karst phenomena, of which a big cave at Lulletjarro is described, are formed by the present streams. However, karst formation caused by water action at the time of ice recession also occur. Jan Lundqvist

**Sahlström, K. E.:** Jordskalv i Sverige 1941—1950 (Erdbeben in Schweden 1941—1950). — Sthlm, S. G. U. Ser. C. N:o 532 [= Årsb. 47 (1953) N:o 2]. 1953. 33 S. 20 Textfig. 1 Tafel. — Die Einsammlung makroseismischer Beobachtungen über in Schweden eingetroffene Erdbeben ist seit etwa 50 Jahren an der Geologischen Landesanstalt Schwedens fortgesetzt worden. Der Verf. hat die Beobachtungen für die Jahre 1941—50 zusammengestellt und mit Spezialkarten und einer Übersichtskarte veröffentlicht. Nur 22 Erdbeben wurden in diesem Zeitraum beobachtet, was nur die Hälfte der Anzahl der voriger Jahrzehnten entsprächt. 1941—50 sind in Schweden eine in seismischer Hinsicht ruhige Zeit gewesen, die (1954) noch fortdauerte. Die zwei grössten Erdbeben erreichten eine Ausbreitung von 15 000—20 000 km². Die Intensität hat den Stärkegrad IV nicht wesentlich überschritten und die meisten Beben lokalisieren sich zum südwestlichen Schweden und gehören also der sogenannten Oslo-Wänerregion an. K. E. Sahlström

**Troedsson, Tryggve:** Om blockräkningar. Ett genmäle (On counting of boulders. A rejoinder). — Sthlm, G. F. F. Bd 75, 1953, p. 307.

**Werner, S.:** Interpretation of magnetic anomalies at sheet-like bodies. — Sthlm, S. G. U. Ser. C. N:o 508 [= Årsb. 43 (1949) N:o 6] 1953. 130 pp., 3 tables pp I—XXI. — New methods are described for calculating the parametres of a lenticular body from the magnetic anomaly. In these methods profile curves, representing the intensity of one or two components of the magnetic anomaly, form the basis of the calculations. Only a fixed number of points on such profile curves are necessary for the calculations and these points may be chosen at will. Three different cases are treated, *viz.* when the magnetic body can be considered as constituting 1) a thin sheet of infinite length, 2) a thin sheet of finite length, and 3) two thin sheets or one thick sheet. In addition, the technics of calculation are especially described. The application of the methods of interpretation is illustrated on five actual examples from iron ore deposits. Three of the treated anomalies originate from Oberhartz in Germany. Further an interpretation is made of a profile curve of the total intensity measured by an airborne magnetometer across the Benson Mines, Adirondac district, U. S. A. Finally it is treated two profile curves representing the vertical and horizontal intensities along a profile line across the vast Russian ore deposit in the Kursk district.

S. Werner

***Wickman, Frans E.:** Hur man sökt bestämma jordens ålder (How one has tried to determine the age of the Earth). — Sthlm, Populär Astron. Tidskr. 1953, pp. 135—142, 1 text-fig.

## Géochimie

**Landergren, S.:** Über die Gleichgewichtserscheinungen im Austausch der tabilen Kohlenstoffisotope in marinen Sedimenten. — Zeitschr. für Natur-orschung, Bd 8 b, Heft 10, 1953. S. 537—541. — Die Schwankungen in der elativen Verteilung der beiden Kohlenstoffisotope $^{12}$C und $^{13}$C in marinen edimenten werden diskutiert. Es wird gezeigt, dass die Schwankungen in ngem Zusammenhang mit den geologisch-hydrographischen Verhältnissen m Milieu der Carbonatabsetzung stehen. Im Austausch der Isotope bei der Carbonatbildung im Meere wird ein Gleichgewicht ganz oder annähernd rreicht, was mit Beispiele des Isotopenaustausches zwischen organischem nd Carbonatkohlenstoff in schwedischen Alaunschiefer gezeigt wird.

S. Landergren

**Ljunggren, Pontus:** Some data concerning the formation of manganiferous nd ferriferous bog ores. — Sthlm, G. F. F. Bd 75, 1953, pp. 277—297, 5 ext-figs. — In connection with a discovery of oxidic manganiferous and erriferous precipitations in northern Vermland and north-western Dalecarlia pH measurements of different waters and chemical analyses of waters and bog ores were carried out. The origin of the different bog ores is dealt with in onnection with a discussion of some problems of the geochemistry of manganese and iron.

Author's abstract

**von Ubisch, Hans:** Mass spectrometry and mineralogy. — Sthlm, G. F. F. 3d 75, 1953, pp. 469—489, 8 text-figs. — A review article dealing with the pplication of nuclear science on mineralogical and geological problems with pecial emphazis on the work done in America.

F. E. Wickman

**Wickman, Frans E.:** Wird das Häufigkeitsverhältnis der Kohlenstoff-sotopen bei der Inkohlung verändert? — London, Geochim. et Cosmochim. cta 1953, Vol. 3, pp. 244—252, 3 text-figs. English abstract p. 244. — Three series of coal samples representing Pliocene, Wealden, and Carboni-erous have been investigated. Metamorphism has no traceable influence n the $^{12}$C/$^{13}$C ratios. Various factors are briefly discussed in order to explain he observed isotope ratios. Often carbonates in coal do not seem to have een formed from plant carbon dioxide which is contrary to common views n their origin.

Author's abstract

## Minéralogie et cristallographie

**Chen, Kwan Yuan:** Studies in sodium-poor potash feldspars. — Bull. Geol. nst. Upsala, Vol. XXXIV, 1949—1953, pp. 297—376, 28 text-figs. Uppsala 953. — Alkali feldspars are examined from a feldspathic dyke and a nephe-ne- and epidote syenite in Tzuchinshan (The Golden Purple Mountain) in hansi, China. A triclinic variety is present among the ordinary orthoclase nd is easily distinguished from microcline by the magnetude of extinctions n (001) and (010) and the absence of cross-hatching twinnings.

E. Åhman

**Marmo, Vladi:** Schungite — a pre-Cambrian carbon. — Sthlm, G. F. F. d 75, 1953, pp. 89—96, 2 text-figs. — In comparatively pure schungite it is ncerned that the vanadium content is not an essential component, but

must be related to the impurities occuring in the schungite. According to data from X-ray analyses, schungite is to be considered as a species different from graphite. From the author's conclusions

**Mason, Brian** and **Greenberg, Seymour S.:** Zeolites and associated minerals from southern Brazil. — Sthlm, K. V. A. Ark. f. mineralogi o. geologi Bd 1 Nr 18, pp. 519—526, 1 text-fig. Uppsala 1953.

**Mellis, O.:** Replacement of plagioclase by orthoclase in deep-sea deposits. — Nature, Vol. 169. 1952. — In a core taken by the Swedish Deap Sea Expedition in 1948 in the north-western Atlantic Ocean fragments from gabbro and anorthosites show replacement of plagioclase by orthoclase. All stages of transformation are observed. E. Åhman

**Mellis, O.:** Cristaux sphériques du grès calcareux. — Cahiers Géologiques de Thoiry, XVI—XVII, 1953. — Die Kristalle sind in einem lockeren Devonsandstein in der Nähe des Dorfes Sigulda in Lettland angetroffen worden. Sie werden auf Wasserlösungen zurückgeführt, die aus über ihnen liegenden devonischen Karbonatgesteinen herstammen. Die als einzelne oder Drusen ausgebildeten Kristallen zeigen regellose optische Orientierung.
E. Åhman

**Norin, Erik:** Occurrence of authigenous illitic mica in the sediments of the Central Tyrrhenian Sea. — Bull. Geol. Inst. Upsala, Vol. XXXIV, 1949—1953, pp. 279—284, 2 plates.

**Quensel, Percy:** The paragenesis of the Varuträsk pegmatite. — Geological Magazine, Vol. LXXXIX, 1952, pp. 49—60, 1 text-fig. — A preliminary report is presented on the paragenesis of the Varuträsk pegmatite, situated about 10 km. from Skellefteå in Sweden. Three main stages can be distinguished: a) An epimagmatic-pegmatitoid stage during which the primary zonal development of the pegmatite body into border zone, wall zone, intermediate zones, and core was accomplished; b) a hydrothermal replacement stage, divisible into a high temperature phase with a Li-replacement unit and a Cs-replacement unit, and a lower temperature phase with a cleavelandite replacement unit and a feebly developed fluorite unit; c) a final stage of supergene alteration. The age of the pegmatite lies between 1 650 and 1 800 million years. Author's abstract

**Sundius, N.** and **Byström, A. M.:** Decomposition products of muscovite at temperatures between 1 000° and 1 260° C. — London and Beccles, Trans of the British Ceramic Society, Vol. LII. Nov. 1953. pp. 632—642, 2 text-figs. — Samples of muscovite were heated at temperatures between 1 000° and 1 260° C. and the decomposition products were studied under the microscope and by means of X-ray photographs. The muscovite is completely decomposed at 1 000°—1 200° C. and at this temperature has been changed to a pseudomorph rich in glass and containing mullite and $Al_2\,O_3$ (corundum or $\Theta - M_2O_3$). The pseudomorph behaves as an individual and it exhibits double refraction, etc. Abstract of the authors

**Uytenbogaardt, W.:** On the opaque mineral constituents in a series of amphibolitic rocks from Norra Storfjället, Västerbotten, Sweden. — Sthlm, K. V. A. Ark. f. mineralogi o. geologi Bd 1, nr 19, pp. 527—543, 2 text-figs., 11 plates. Uppsala 1953. — Exsolution intergrowths of titanhematite, $Fe_2O_3$-bearing ilmenite and titaniferous magnetite are found on a large scale within the plagioclase amphibolites, rocks which had previously been considered to be of sedimentary origin. These intergrowths must once have been solid solutions and on these grounds these amphibolites are considered to be of gneous origin. From the author's summary

**Volborth, A.:** Zwei Apophyllitfunde in Ihalainen und Pyterlahti, SE—Finn-and. — Sthlm, G. F. F. Bd 75, 1953, S. 360—366, 2 Textfig.

**Wickman, Frans E.:** The crystal structure of aikinite, $CuPbBiS_3$. — Sthlm, Ark. f. Min. o. Geol. Bd 1 nr 16, pp. 501—507, 4 text-figs. Uppsala 1953. — Cell dimensions, space group and atomic parameters given. The structure is found to be very similar to that of stibnite and $K_2CuCl_3$.
F. E. Wickman

## Minerais

**Assarsson, G.:** Undersökning av torvmossar (Investigation of peat-bogs). — Statens Bränslekommission. Torvproduktionens framtid, pp. 40—45. Duvbo 1952. — The volume of the different kinds of peat occurring in the peat-bogs n Southern Sweden, and the amount of fuel calculated from this are mentioned. The mode of measuring the supply of the fuel of the large bogs in Southern as well as in northern Sweden is discussed. G. Assarsson

**Bergenfelt, Sven:** Om förekomsten av selen i Skelleftefältets sulfidmalmer (On the distribution of selenium in sulphide ores of the Skellefte district, N. Sweden). — Sthlm. G. F. F. Bd 75, 1953, pp. 327—359, 15 text-figs. English summary pp. 327—328. — The investigation shows that galena usually belongs to those minerals high in selenium in relation to the average selenium content of the ores and that pyrite generally belongs to the minerals low in selenium. Small quantities of sulfomineral inclusions often occur in galena, and these probably have an important influence on the selenium content of the mineral. From the author's abstract

**Clemensson, Gustaf:** Den skånska stenkolsbrytningens historia intill 1658 (History of coal mining in Scania up to 1658). — Stenkol och lera. Skildringar kring Höganäsbolagets och dess föregångares verksamhet utgivna av Höganäs Billesholms AB. 1, pp. 217—306, 14 text-figs., 8 plates. Uppsala 1953. — The history of coal-mining in N. W. Scania is followed up from the discovery of coalbeds, in 1571, to 1658, the year of Denmark's ceding the province to Sweden. The quarrying was run partly by the Danish Government, and partly by private entrepreneurs. The output was very modest but yet of a certain economic importance. G. Regnéll

**Högbom, Ivar:** Europas kolfält (The coal-fields of Europe). — Stenkol och lera. Skildringar kring Höganäsbolagets och dess föregångares verksamhet utgivna av Höganäs—Billesholms AB. 1. pp. 11—26, 3 text-figs. Uppsala 1953.

**Kampmann, P.:** Bly- og zinkforekomster i Nordøstgrønland (Occurrences of lead and zinc in Northeast Greenland). — Sthlm, IVA, Årg. 24, 1953, pp. 94—303, 10 text-figs.

**Magnusson, N. H.:** Sveriges Geologiska Undersöknings borrningar efter salt och olja (Drilling for salt and oil by the Geological Survey of Sweden). — IVA Årg. 24, 1953: 1, pp. 27—33. English abstract p. III. — The question of deep drilling in Scania had been repetedly discussed since the turn of the century, on some occasions even in the Swedish Parliament, before the Geological Survey of Sweden in 1938 started geophysical and geological surveys in the southwest portion of the province, which surveys were to be followed by deep drillings for salt and oil. Between 1941 and 1951 four deep drill holes were sunk, two at Höllviken, one at Trelleborg, and one at Svedala. It was ascertained by means of these drillings that in an area of at last 300 km² there were to be found at 1 200 to 1 500 m depth brine containing layers with about 16 % salt of which almost 2/3 was NaCl and 1/3 $CaCl_2$. In the deepest drillings, which went down into new red sandstone, traces of oil were also observed. Permian layers with solid salts have not yet been found, but comparison with conditions in Denmark and Germany makes it probable that such layers extend also into Scania and new geophysical measurements suggest that outcrops of solid salt may exist at some points. The Geological Survey of Sweden is at present planning a new drill hole to such a supposed outcrop. Author's abstract

**Strömberg, Sven och Ödeen, Stig:** Smålands Taberg. Utredning rörande frågan om åtgärder till skydd för Smålands Tabergs naturvärden (Report on actions for the preservation of natural scenery at Smålands Taberg). — Sthlm. Statens offentl. utredn. 1953: 33. Jordbruksdepartementet. 55 pp. 7 text-figs.— The geological part is entirely referring to previous works by S. Hjelmqvist and E. Nilsson. The report ends with a proposal that gives the mining company all the advantage. Jan Lundqvist

**Ödman, Olof H.:** A Mineração de Metais na Suecia e Seu Panorama Geológico (Metal Mining in Sweden and Its Geological Background) — Rio de Janeiro, Engenharia, Mineração e Metaluriga, Vol. 18, 1953, pp. 221—226. — Summary of development of metal mining in Sweden, giving location of the principal mining districts, types of ore mined, metal contents and production figures. Geological and geophysical prospecting methods practised in the country are described. The geology and mineralization of the mining districts are briefly discussed. O. H. Ödman

**Öystein Heen, M. N. I. F.:** Utnyttelsen av Svalbard-kull. (Exploitation of the Svalbard coal). — Sthlm, IVA, Årg. 24, 1953, pp. 312—320, 2 text-figs.

## Géologie appliquée

**Caldenius, Carl:** Geologiska synpunkter vid planering och utsprängning av bergrum (Geological points of view on projecting and blasting of shelters in solid rocks). — Sprängning av bergrum, Sthlm 1953. Forskarnas kontaktorg vid Ingeniörsvetenskapsakad. Medd. F. K. O. nr 14. 9 pp. 4 text-figs.

**Eriksson, Gösta A.:** Aktuellt om Österrikes järn- och stålindustri (Österreichs Eisen- und Stahlindustrie). — Sthlm, Ymer, årg. 73, 1953, S. 192—211, 7 Textfig. Deutsche Zusammenfassung S. 210—211.

**Hellström, B.:** The ground water supply of northeastern Sinai. — Sthlm, eogr. ann. Årg. XXXV, 1953, pp. 61—74, 16 text-figs.

**Jansa, O. Victor E.:** Artificial ground-water supplies of Sweden. Descriptions nd experiences. — Union Géodésique et Géophys. intern. Ass. Int. d'Hydro-ogie Scient. Assembl. Gén. de Bruxelles 1951. T II. Also as: Bull. No 38 of he Inst. of Technology Stockholm, Sweden. 15 pp. 12 text-figs.

**Kjellman, W., Cadling, L., and Flodin, N.:** A new geotechnical classification ystem. — R. Swed. Geotechn. Inst. Proceedings No. 6. 34 pp. 2 text-figs. thlm 1953. — A good geotechnical classification system is of great import-nce, above all for the classification of geotechnical literature. Three classi-ication systems have hitherto been used in geotechnics; all have deficiencies nd inconveniencies. A new, detailed geotechnical classification system is resented. It is constructed according to the decimal principle, and to some xtent with the UDC System as a pattern. Its present application to classi-ication of geotechnical literature is described. Summary of the authors

**Lundberg, Hans:** En malmletare — på marken och i luften (An ore-prospec-or — in the field and in the air). — Sthlm, Blad, f. Bergshandt. Vänner, Bd 0, pp. 285—311, disc. pp. 312—316, 26 text-figs. Uppsala 1953.

**Magnusson, Nils H.:** Sveriges geologiska undersökning i näringslivets tjänst The Geological Survey of Sweden and its share in the economic development f the country). — Sthlm, IVA 24 (1953): 5, pp. 194—202. English abstract . III. — The Geological Survey of Sweden was established in 1858. To begin vith its work was almost entirely directed to geological mapping and the artographic work still continues to be its most important mission. Side by ide with this, as years have gone by, the Survey has acquired more and more ractical objects. The most important of these is prospecting for ore, mainly arried on in Upper Norrland and particulary directed to copper ores. Valuable vork has been done in respect of non-metallic mineral raw materials, such as imestones and alum slates. In the extreme south-west of Scania, drillings ave been made for salt and oil. The programme of the Survey further com-rises geological-geotechnical research, besides agrogeological, hydrological nd peat-geological work. Scientific work, of a fundamental nature for prac-ical problems and map-making, plays a great part in the activity of the urvey. Author's abstract

**Morfeldt, Carl-Olof:** Inventering genom borrning av fyndigheter för dag-rytning (How to make an inventory by drilling of open cut mining deposits). – Sthlm, Tekn. Tidskr. Årg. 83, pp. 237—240, 9 text-figs. Norrköping 953.

**Segerros, Henning:** Grus- och sandtäkt under kontroll (Control of the ex-loiting of gravel and sand). — Sthlm, Sv. Vägfören:s Tidskr. Årg. XL, p. 144—149, 5 text-figs. Norrtälje 1953. — The author discusses the destruc-ion of natural scenery, caused by the exploiting of gravel and sand and uggests some measures to diminish the damage. Jan Lundqvist

**Winqvist, Gustav:** Ground water in Swedish eskers. — Sthlm, K. Tekn. ögsk. Handl. Nr 61, 91 pp., 22 text-figs. Also as: Bull. No 30 Inst. Hydraul. oy. Inst. Techn. Göteborg 1953. — Eskers, i. e. gravelly and sandy drift formations deposited by subglacial streams, are known in Sweden under the name of »åsar», and constitute a characteristic geological feature of this country. One of the most remarkable eskers in Sweden is the Uppsala Esker, which extends from the south-west part of the district of Södertörn, in the south, to the mouth of the river Dalälven in the north. The observed length of the Uppsala Esker is about 200 km. The most interesting part of the esker is that stretch which serves as a source of water supply, e. g. for the city of Uppsala. In this part of the esker, the ground water surface exhibits hydraulic continuity to the south from Uppsala to Flottsund. To the north observations seem to indicate that a watershed can lie as far north as Lake Vissjön. The distance from Flottsund to Lake Vissjön is about 38 km. The calculated total ground water supply which is available in the urban area of Uppsala has been found to be about 300 l/s. This calculation is based on observations made over many years at the Galgbacken Municipal Waterworks. A numerical relation has been deduced for determining the available ground water supply, and this relation has proved to be in close agreement with the actual conditions, in spite of wide variations in the rate of precipitation, the ground water level, the rate of pumping and other factors. It is seen from this calculation that the available ground water supply is fairly constant during different seasons, and varies very slightly from one year to another. Good results have been obtained by using this method of calculation for determining the ground water supply available in some other eskers, e. g. at the Södertälje Municipal Waterworks, and at the water intake of the city of Umeå. Extensive observations were made at both these places.

From the author's summary

## Géologie des formations préquaternaires

### Géologie et pétrographie des roches cristallines

**Asklund, B.:** Marmorbruksområdet på Kolmården, bergarter och tektonik (The Marmorbruket marble area at Kolmården, rocks and tectonics). — Sthlm, G. F. F. Bd 75, 1953, pp. 419—427, 2 text-figs. — Since long ago the Marmorbruket marble area of Kolmården in the northern part of the province of Östergötland is the principal district for marble-quarrying in Sweden. Its green-coloured serpentine-marble is a very valuable monument and building stone, well known also on the export-trade as »Swedish green marble». This rock forms a series of occurrences from the Baltic to the lake of Vättern in the middle part of South Sweden. In this area the marble occurs as layers in the Archean limestone strata belonging to the leptite-formation, the oldest complex of the Archean. The surrounding rocks are »leptites», highly metamorphosed volcanic rocks of mainly liparitic composition. A detailed description of the stratigraphy of the marble-bearing field is given. Of special interest are the intercalating layers of partly extremely potash-rich leptites with a potash-content of up to 10 or 12 per cent $K_2O$. They are combined with potash-bearing amphibolites of monzonitic type which together with the potash leptites seem to form layer-shaped intrusives or sheets in the adjacent leptites mainly of tuffitic origin. In connection with these intrusions metasomatic ore-formation seems to have occurred, giving rise to unimportant occurrences of iron-ores in the leptites and »skarns» (taconitic rocks) as reaction

roducts of small parts of limestone attacked by the ore-forming solutions.
'he origin of the marble is a work of the regional metamorphism which has
iven rise to originally pyroxene and hornblende-bearing recrystallized lime-
tones whose dark minerals through diaphtoritic processes were trans-
ormed to serpentine. The leptite-limestone-complex was invaded by two
ifferent granite-series, the youngest followed by intrusions of mighty peg-
natite-stocks characterized by tourmaline. The marble-bearing area forms a
ynclinorium laying on the southern slope of a wide anticlinic zone in the
rchean. Thanks to the marble-quarrying which has reached more than 100
netres in depth it has been possible to find what is up or down in the whole
tratified leptite series. The marble-layers often form very distinct small
ynclines or anticlines. There are a lot of E.—W.-directed length-folds with
teep falling, but there also occurs an isoclinic transversal folding showing
he most complicated round-bending of the strata. This folding-type is typical
or the Archean of the coast-region of Southeastern Sweden and seems to
ave originated contemporaneously with the intrusion-process of the younger
rchean granites. During the long period of regional metamorphism and
ntrusion-processes a partial re-melting of the leptites occurred, producing
venite-gneisses» with veins of aplitic-pegmatitic composition. A detailed
tudy of the composition of the acid veins has shown that the palingenetic
naterial consists of alkali-feldspars and quartz. Microcline and albitic feldspar
re equal in quantity, showing that the re-melting processes have been able
o form acid melts nearly corresponding to the composition of a quartz-alkali-
eldspar-eutecticum. The other acid rocks with a higher content of potash-
eldspar and lacking or only low percentage of albite have been the subject
f recrystallization but not re-melting. B. Asklund

**Asklund, Bror:** Till frågan om Sjöfallssedimentens och Ledfatsområdets
tällning (To the question about the stratigraphical position of the Sjöfall-
ediments and the area of Ledfat). — Sthlm, G. F. F. Bd 75, 1953, pp. 517—
20. — A paper read by prof. Sven Gavelin rose a lively discussion about the
tratigraphical position of two different pre-Cambrian series of strata in
apland. The author expresses his meaning that the clastic part of the Led-
at-area, containing conglomerates and sandstones, corresponds to the Varg-
ors—Vakko-formation of Lapland and represents transgression-sediments
f an early Algonkian wide-spread formation. There must exist a deep-
eaching difference between this formation and the underlying various series
f pyroclastic type especially since it has been shown that granites of the
evsund-group invade the pyroclastics and, on the other side, occur as pebbles
the upper clastic series, represented by the Ledfat-sediments.
B. Asklund

**Du Rietz, Torsten:** Geology and ores of the Kristineberg deposit, Vester-
otten, Sweden. — Sthlm, S. G. U. Ser. C. N:o 524 [= Årsb. 45 (1951),
:o 5], 1953. 90 pp. 43 text-figs. 4 plates. — The Kristineberg deposit is
tuated in a pronounced zone of weakness in the volcanic complex close to
e contact of the Jörn granite at the southern slope of a projection of a
örn-granite anticline. Later on a stronger fissuring occured in this area, the
rrounding rocks becoming metasomatically altered with deposition of
rite ores in fissures and as replacement of the wall rocks. The next ore-
aring solutions were rich in copper and zinc. Owing to alteration processes

and the deposition of ore the equilibrium of the rock complexes was disturbed and the area was cut by faults. The sulfide ores at Kristineberg are almost free from pyrrhotite and arsenopyrite, which is unusaul for the ores of the Skellefte District. From the author's summary

Exkursionen den 14—15 maj 1953 (The excursion of May 14.—15. 1953). — Sthlm, G. F. F. Bd 75, 1953 pp. 427 -432, 2 text-figs. — In order to study the Marmorbruket marble-area at Kolmården and the granites and associated basic rocks of the adjacent Stavsjö area the Geological Society of Stockholm had arranged a two-days excursion under the leadership of Dr B. Asklund. A group of 32 members participated and had the opportunity to study and discuss the many problems of Archean geology represented in the areas mentioned. B. Asklund

**Gavelin, Sven:** Die Beziehungen zwischen Sulfidvererzung und Granitbildung im Skelleftefeld, Nordschweden. — Geol. Rundschau Bd 42, 1953. pp. 44—54, 1 Textfig. — An older and a younger granite occupy wide areas in a finegrained metamorphosed sedimentary series in northern Sweden. Relict structures show that these granites were produced by metasomatic granitization. The metals in the Au and As rich polymetallic Skelleftefield were derived from the original trace elements of the sediments driven out during the younger granitization. A characteristic of this metamorphogenous ore formation, which is unmistakably connected with the granite formation in time, is the lack of any zonal arrangement. The ore paragenesis and mineral succession anticipate those of magmatic deposits in many ways.

Author's summary

**Gavelin, Sven:** Om jämförelsen mellan Sjöfallssedimenten och Ledfatsområdets sedimentbergarter (The connection between the Sjöfall sediments and the sedimentary rocks of the Ledfat area). — Sthlm, G. F. F. Bd 75, 1953, pp. 407—410. — A direct connection between the Siöfall series and the Ledfat sediments is not possible on the basis of our present knowledge of their geological relationship. E. Åhman

**Högberg, Erik:** Relationerna mellan dolomit och kalksten inom karbonatstensområdet vid Sala (The relations between dolomite and limestone in the carbonate-stone area at Sala). — Sthlm, G. F. F. Bd 75, 1953, pp. 247—271, 17 text-figs. English summary pp. 269—270. — The paper gives a description of the deposit of metamorphic dolomite and limestone at Sala in Central Sweden. By special staining methods published in these transactions (1950, p. 348—356) the relationship between calcite and dolomite have been examined in drill-cores and in the field by the staining of rockfaces. Calcite is stained dark whereas dolomite remains uncoloured. The calcite grains in the dolomite seem to be a relict from a primary limestone.

From the author's summary

**Högberg, Erik:** Beräkningar av kalcit-dolomitförhållandet i karbonatbergarter (Calculations of the ratio calcite/dolomite in carbonate rocks). — Sthlm, G. F. F. Bd 75, 1953, pp. 493—496, 2 text-figs. English abstract p. 493. — The present paper gives a description of two diagrams, which have been constructed for calculating the ratio calcite/dolomite from chemical analysis of metamorphic carbonate rocks. By the diagrams has been proved, that almost all Swedish dolomites contain calcite. Author's abstract

**Koark, Hans J.:** Über Querfaltung, Bewegung // B und Erzlagerung mit eispielen aus Malmberget, Gällivare. — Bull. Geol. Inst. Upsala, Vol. XXIV, 1949—1953, S. 251—278, 13 Textfig. — Der Verfasser diskutiert ie tektonische Entwicklung der Lagerstätte Malmberget auf Grund einige it Dioptergoniometer gefügekundlich analysierte Teilbereiche. Hierbei wird ngehend die Querfaltung als B $\gtrless$ B' Gefüge und ihr Einfluss auf die Lagerung es Erzes behandelt. Ausserdem kommt der Verfasser zu dem Schluss, dass almberget vor seine Umformung nicht eine Erzscheibe ähnlich Kiruna hat in können, sondern dass ein stratigraphischer Verband mit Erzlagen in erschiedenen Niveaus vorgelegen haben muss. E. Åhman

**Larsson, Ingemar** and **Fröberg, Carl-Erik:** A reconstruction of an ancient lding in Pre-Cambrian. — K. Fysiogr. Sällsk. i Lund Förh. Bd 23 Nr 9. pp. 10 text-figs. Lund 1953. — A reconstruction of a pre-cambrian folding the rocks of western part of Blekinge has been done in accordance with ethods of B. Sander and by mathematical analysis of dispersed average tas. E. Åhman

**Ljungner, Erik:** De bohuslänska diabasgångarnas ålder (Age of the dolerite kes in Bohuslän). — Sthlm. G. F. F. Bd 75, 1953, p. 112. — The westnorthestern dolerite dikes of Bohuslän (and Halland) have never been seen to t the Bohus granite. The writer therefore considers them older than this ck. P. H. Lundegårdh

**Lundegårdh, Per H.:** Västkustens västnordvästliga diabasgångar (The stnorthwestern dolerite dikes of the Swedish West-Coast). — Sthlm, F. F. Bd 75, 1953, p. 298. — The writer interprets the westnorthwestern lerite dikes of Bohuslän and Northern Halland as Algonkian. P. H. Lundegårdh

**Lundegårdh, Per H.:** Petrology of the Mölndal—Styrsö—Vallda region in e vicinity of Gothenburg. — Sthlm, S. G. U. Ser. C. N:o 531 [= Årsb. 47 953) N:o 2], 1953, 58 pp., 25 text-figs., 1 plate. — The bed-rock immediately of Gothenburg is essentially composed of Middle Archaean, *viz.* Gothian, ks. Two series of supracrustal rocks have been distinguished, both comsing sediments and volcanics. Among these a conglomerate with tuffitic trix and a red alkaline gneiss with a peculiar, crossitic amphibole ought to mentioned. The predominant granites are late Gothian, in part intruded secondary (palingenic) magmas, in part developed by granitization *in situ* sedimentary rocks especially). A small intrusion of late Karelian Bohus nite was discovered during the field work. A number of westnorthwestern erite dikes, probably Algonkian, cut the Archaean bed-rock of the region. P. H. Lundegårdh

**undqvist, Jan:** En postkarelsk peridotit i urberget norr om Torneträsk post-Karelian periodite in the Archaean bed-rock north of Lake Tornesk, Northern Sweden). — Sthlm, G. F. F. Bd 75, 1953, pp. 77—88, 10 t-figs. English abstract p. 77. — The peridotite is of the same type as is nd in the mountains along the Swedish — Norwegian border. These rocks ong to the deepest parts of the Caledonian geosyncline. The described idotite is situated several kilometres east of the Caledonian mountains.

It is intrusive in the late-Karelian granite. As no other rock of this kind younger than the granite, is known and as Caledonian faults are seen in th neighbourhood, the peridotite is possibly of Caledonian age.

Jan Lundqvist

**Morfeldt, Carl-Olof:** Fynd av runda granitblock i pegmatit (Finds of rounde granite boulders in pegmatite). — Sthlm, G. F. F. Bd 75, 1953, pp. 298-299, 2 text-figs. — In a pegmatite dyke at Söderåsen, Scania, boulders c a red granite are found. They are 0,25—0,75 metres in cross-section.

Jan Lundqvist

**Tilley, C. E.:** The grennaite of Norra Kärr. — Sthlm, G. F. F. Bd 75, 195 pp. 321—326, 1 text-fig. — In grennaite is reported by Törnebohm (190 and Adamson (1944) the occurrence of highly sodic nepheline according t an analysis by Mauzelius. A new chemical study of grennaite and its nepheli has been carried out and the composition of the nepheline falls in a diagra into position close to the composition suggested for normal nepheline.

E. Åhman

**Viluksela, E.:** Urbergets petrografi och stratigrafi inom Sjöfall—Ultevi området i Norrbotten (Petrography and stratigraphy of the Archaean in th Sjöfall—Ultevis district, Norrbotten). — Sthlm, G. F. F. Bd 75, 1953, p. 31 disc. Geijer, Asklund, G. Kautsky pp. 314—317.

**Åhman, Erik:** Vallen-Alhamnområdet i Nederluleå s:n (The Vallen—Alham area, parish of Nederluleå, N. E. Sweden). — Sthlm, S. G. U. Ser. C. N 529 [= Årsb. 46 (1952) N:o 5] 1953, 21 pp. 7 text-figs. 1 plate. — The roc of the Vallen-Alhamn area consist of an older and a younger supracrustal seri with associated acid and basic intrusives. The younger series consists of arco and granite-ball-bearing conglomerate belonging to the Karelian Bälin series (Åhman & Ödman 1952) which is in part layered on rocks belongi to the older supracrustal series. From the author's abstract

**Ödman, Olof H.:** Norrbottens läns urberg i kort sammandrag (Pre-Cambria geology of the Norrbotten Province, N. Sweden). — Sthlm, G. F. F. Bd 7 1953, pp. 49—71. English abstract p. 49. — Summary of progress of t geological survey of the pre-Cambrian in the Norrbotten Province in Sweden. Two cycles are recognized: the Sveco-Fennic and the Karelidi The former is composed of volcanic rocks, overlain by sediments and intru ed by granites of two ages. Two phases of folding, contemporaneous with t intrusives, occurred. The younger Karelidic cycle is built up of three series volcanic and sedimentary rocks. Also during this cycle two phases of foldi and deep-seated intrusion are recognized. O. H. Ödman

## Géologie et pétrographie des formations postarchéennes

**Hadding Assar:** Den kolförande lagerserien i Skåne och dess förhålland till övriga geologiska bildningar i Norden (The coal-bearing series strata in Scania and its relation to other geologic formations in Scandinavi — Stenkol och lera. Skildringar kring Höganäsbolagets och dess föregånga verksamhet utgivna av Höganäs—Billesholms A.B. 1, pp. 75—91. Uppsa

53. — A survey of the geologic development of Scandinavia and partic-arly of Scania. Special attention is paid to the formation of the coal-earing Rhaetic-Liassic series of strata which is unique to Scania where weden is concerned.
G. Regnéll

**Hessland, Ivar:** Investigations of the Senonian Kristianstad district, S. weden. II Sedimentology and lithogenesis of the Åhus Series. — Bull. Geol. ist. Upsala, Vol. XXXIV, 1949—1953, pp. 45—106, 4 text-figs. 1 plate 950). — The problem set in the sub-title of the paper was tackled by a omprehensive examination of a core obtained from a drill-boring penetrating rough the entire body of Cretaceous strata (177,23 m, ranging from the hus-sandstone — here met with for the first time as rock-in-place — to e Holma-sandstone?) at Åhus, N. E. Scania, referred to as the »Åhus eries» (a term thus used in a sense entirely different from the »Åhus-sand-one»). The Cretaceous history of the district is outlined on the basis of a ealth of data relating to the biogene, organic-chemical, and minerogene ces.
G. Regnéll

**Jaanusson, Valdar:** Über die Fauna des oberordovizischen Slandrom-alksteines im Siljan-Gebiet, Dalarna. — Sthlm, G. F. F. Bd 75, 1953, S. —105, 4 Textfig. English abstract S. 97. — Description of a new section the lowermost Upper Ordovician Slandrom limestone exposed by excava-ons at Gulleråsen, Siljan district. The lower part of the Slandrom limestone, e fauna of which was previously almost unknown, contains *i. a. Chasmops . wesenbergensis*, *Homalops* cf. *altumi*, and *Platylichas laxatus*. It is possible at the lower part of the Slandrom limestone is faunistically different from e upper part, where *i. a. Tretaspis seticornis* occurs.
Author's abstract

**Lindström, M.:** On the lower Chasmops beds in the Fågelsång district, Scania. Sthlm, G. F. F. Bd 75, 1953, pp. 125—148, 6 text-figs. 1 plate. — This per deals with a thin series of Ordovician beds, known formerly as the rthis shale», composed of dark, siliceous shale alternating with yellowish, astic clay similar to the metabentonites of central Sweden. Omnipresent in e shale is a brachiopod referred to generally as *Orthis argentea* HISINGER. is proposed to belong to a new species, *Onniella bancrofti*. New are further *enodonta pulchellula*, *Sphaerocoryphe carinae*, *Primitiella? spiniger*[*a*], and *pidocoleus sularpensis*. Discussed are *Sowerbyella* cf. *sericea*, *Sericoidea stricta* (HADDING), *Aegiria?* sp., and *Pyritonema* cf. *subulare*. Some inform-ive outcrops are described and faunal lists given. The term »Orthis shale» abandoned and is suggested to be replaced by »Sularp shale». Stratigra-ically, it is placed directly above the zone of *Nemagraptus gracilis*.
G. Regnéll

**Ljunggren, Pontus:** On a problematic fossil in Jotnian sandstone. — Sthlm, F. F. Bd 75, 1953, pp. 403—406, 3 text-figs. — Describes some problematic ssils of hitherto unknown type from the Jotnian sandstone of Dalecarlia.
R. Sandegren

**Nilsson, Ragnar:** Några iakttagelser rörande undre och mellersta dicello-aptusskiffern i västra Skåne (Some observations concerning the Lower d Middle Dicellograpters shale in western Scania). — Sthlm, G. F. F. Bd , 1953, pp. 43—48, 1 text-fig. English abstract p. 43. — A mixed fauna of graptolites held to be restricted to the Lower Dicellograptus shale and the Middle Dicellograptus shale, respectively, has been detected in boulders at Sularp in the Fägelsång district, west-central Scania. It is thought to be transitional between that of the Lower and that of the Middle Dicellograptus shale. The graptolite zones represented in the area are discussed. It is suggested that *Nemagraptus gracilis* has a wider stratigraphic range than supposed hitherto. G. Regnéll

**Nilsson, Tage:** Fossilens vittnesbörd om vegetation och djurliv i nordvästra Skåne under stenkolens bildningstid (Flora and fauna in N. W. Scania durin the time of formation of the coal-beds as displayed by fossils). — Stenkol och lera. Skildr. kring Höganäsbolagets o. dess föregångares verksamh. utg. av Höganäs-Billesholms AB. 1 pp. 121—173. 44 fig. Uppsala 1953. — An understandable, well illustrated account of flora, fauna, and life condition in N. W. Scania during the time of formation of the coal-bearing Rhaetic Liassic beds. G. Regnéll

**Norin, Rolf:** Skånes stenkolsfält (The coal-fields of Scania). — Stenkol och lera. Skildringar kring Höganäsbolagets och dess föregångares verksamhet utgivna av Höganäs-Billesholms AB. 1. pp. 92—120. 15 text-figs. 1 plate. Uppsala 1953. — A description of the regional distribution, formation, tectonics, and rocks — particularly coal, fire-clays, and sandstones (in part ferriferous) — of the Rhaetic-Liassic series of Scania, with special reference to N. W. Scania. The position of the Lower Coal Bed (B) in relation to the surface topography is shown on a level-map in full colour. G. Regnéll

## Paléophytologie

**Berger, Walter:** Studien zur Systematik und Geschichte der Gattung Carpinus. Mit Beschreibung einiger neuer Arten aus dem Altpliozän des Wiener Beckens. — Lund, Botan. Notiser 1953, S. 1—47, 15 Textfig.

**Berger, Walter:** Eine neue Carpinus-Art aus dem Oberoligozän des Rheinlandes. Ein Nachtrag zu »Studien zur Systematik und Geschichte der Gattung Carpinus». — Lund, Botan. Notiser 1953, S. 341—344, 1 Textfig.

**Florin, Rudolf:** On the morphology and taxonomic position of the genus Cycadocarpidium Nathorst (Coniferae). — Sthlm, Acta Horti Bergiani T. XVI, pp. 257—275, 3 text-figs. Uppsala 1953.

**Florin, R.:** The female reproductive organs of the Stachyosperms. — Proc. of the 7:th Internat. Botan. Congr. Sthlm july 12—20 1950, pp. 576—578. Uppsala 1953.

**Gothan, W.:** Allgemeine Verbreitung der paläozoischen Floren mit Ausblicken auf die mesozoischen. — Proc. of the 7:th Internat. Botan. Congr. Sthlm july 12—20 1950, pp. 588—590. Uppsala 1953.

**Halle, T. G.:** The Carboniferous flora of East Greenland. — Proc. of the 7:th Internat. Botan. Congr. Sthlm july 12—20 1950, pp. 594—595. Uppsala 1953.

**Horn af Rantzien, Henning:** Staining and plastic embedding of small mineralized plant fossils. — London, Nature, Vol. 171, 1953, p. 516.

**Horn af Rantzien, Henning:** De geologiska resultaten från borrningarna i öllviken. VI: Charophyta from the Middle Trias of the boring Höllviken II. Sthlm, S. G. U. Ser. C. N:o 533 [= Årsb. 47 (1953) N:o 4] 1953. — A eliminary account of a small and stratigraphically rather isolated charoıyte flora represented solely by gyrogonites. The species distinguished e characteristically distributed vertically. Species of Characeae, though und throughout the profile, dominate the lower zone, whilst the Clavatoceae are confined to the upper zones. R. Sandegren

**Kautsky, Gunnar:** Ett fossilfynd i Susendalen (Ein Fossilfund im Susental, orwegen). — Norges Geol. Unders. Nr 184, S. 142—144, 2 Textfig. Deutsche ısammenfassung S. 144.

**Lundblad, Britta:** Heterosporous Lycopodiinae in Mesozoic floras. — Proc. the 7:th Internat. Botan. Congr. Sthlm july 12—20 1950, pp. 595—596. ppsala 1953.

## Paléozoologie

**Bohlin, Birger:** The affinities of the graptolites. — Bull. Geol. Inst. Upsala, ol. XXXIV, 1949—1953. pp. 107—113, 6 text-figs. (1950). — Author raises rtain objections to KOZLOWSKI's interpretation of the graptolites as closely lated to the Pterobranchia. The resemblance is considered to be altogether perficial. WIMAN's opinion of the graptolites as an entirely independent oup is advocated. G. Regnéll

**Bulman, O. M. B.:** Some graptolites from the Ogygiocaris Series of the Oslo strict. — Sthlm. Ark. f. Min. och Geol. Bd 1 nr 17, pp. 509—518, 4 text-figs., plates. Uppsala 1953.

**Carlsson, J. G.:** The Cretaceous Cirripedes of Sweden. — Lunds Univ. sskr. N. F. Avd. 2. Bd 49. Nr 1. K. Fysiogr. Sällsk. Handl. N. F. Bd 64. 1. 39 pp., 6 plates. Lund 1953. — 22 species and sub-species of cirripedes m the Cretaceous of S. Sweden are dealt with monographically, 20 of which Senonian and 2 Danian of age. *Pycnolepas ignabergensis* is new to Science. *rtiscalpellum glabrum*, *C. striatum*, *C. s. dissimile*, *Arcoscalpellum maximum catum*, and *A. fossula* were not recorded previously from Sweden.
G. Regnéll

**Ekblom, Tore:** Studien über subfossile Lemuren von Madagaskar. — Bull. ol. Inst. Upsala, Vol. XXXIV, 1949—1953, S. 123—190, 2 Textfig., 5 feln.

**Jaanusson, Valdar:** Untersuchungen über baltoskandische Asaphiden. I. vision der mittelordovizischen Asaphiden des Siljan-Gebietes in Dalarna. — lm Ark. f. Min. o. Geol. Bd 1 nr 14, S. 377—464, 15 Textfig. 10 Tafeln. psala 1953. II. Revision der *Asaphus* (*Neoasaphus*)-Arten aus dem schiebe des südbottnischen Gebietes. — Ibid. nr 15, S. 465—499, 6 Textfig. Tafeln. Uppsala 1953. — Pt. I begins with a chapter on the morphology terminology of the exoskeleton of the Asaphidae, followed by a discussion the criteria used for distinguishing the genera. Then follows a note on metry in *Asaphus* with reference to the eyes. 7 genera are dealt with, the owing of which are new: *Ogmasaphus*, *Plectasaphus*, *Pseudomegalaspis*,

and *Xenasaphus*. There is a new subgenus of *Asaphus*, *Neoasaphus*. Two new species are erected, namely *Pseudasaphus limatus* and *Ogmasaphus costatus* out of a total of 11 species. Pt. II contains description of 7 species, among them 2 new ones, namely *Asaphus* (*Neoasaphus*) *pseudornatus* and *A.* (*N.*) *bottnicus*
G. Regnéll

**Jaanusson, Valdar:** Brachiopoda from the Tertiary Nahuel Huapi formation of the Patogonian Cordillera. Appendix. Stål, Erik: A new casting method for paleontological purposes. — Bull. Geol. Inst. Upsala, Vol. XXXIV 1949—1953, pp. 191—203, 3 plates.

**Köster, Erhard:** Die Echiniden der tertiären Nahuel-Huapi-Serie von Nord Patagonien. — Bull. Geol. Inst. Upsala, Vol. XXXIV, 1949—1953, pp. 285-296, 1 Tafel.

**Tjernvik, T.:** Notes on two new trilobites from the Upper Cambrian Sweden. — Sthlm, G. F. F., Bd 75, 1953, pp. 72—76, 2 text-figs. — A new agnostid and a proparian olenid, placed tentatively in the South America genus *Jujuyaspis*, are described.
T. Tjernvik

**Westergård, A. H.:** Non-Agnostidean trilobites of the Middle Cambrian Sweden. 3. — Sthlm, S. G. U. Ser. C. N:o 526 [= Årsb. 46 (1952) N:o 2 1953. 58 pp., 8 plates. — The following genera are dealt with: *Agraulos* (in clusive of *Proampyx*), *Solenopleura*, *Parasolenopleura* nom. nov. (= *Liostracu* Angelin, partim), and *Grönwallia*. The type specimen of *Paradoxides paradoxissimus* (Wahlenberg, 1821) is illustrated. — The present paper is a continua tion of Nos. 498 and 511 of this Series.
A. H. Westergård

**Westergård, A. H.:** Two problematic fossils from the Cambrian in Sweden — Sthlm, G. F. F. Bd 75, 1953, pp. 465—468, 1 plate. — Problematicum is bilaterally symmetrical and furcate, with two or three cusps. These tw forms merge into each other by a continuous series of intermediate links i which the middle cusp varies greatly in length irrespective of the specimen size and, sometimes, is almost as long as the outer cusps. The shell, wholl enclosing a cavity, is very thin, black, glossy or dull, and corneous or ch tinous in part at least. The largest specimens found do not seem to excee 3 mm in length (parallel to the length of the cusps), 1.7 mm in breadth, an 0.4 mm in thickness. It appears in the late Middle Cambrian and ranges int the Tremadocian (*Ceratopyge* shale) in various areas in southern and middl Sweden. It is common in the conglomerate of *Orusia lenticularis* on Ölan in which the whole series of forms occurs, and in the *Ceratopyge* shale a Biludden, northern Uppland, in which only a bicuspidate form has bee observed; otherwise it seems to be rare. — Problematicum II is represente by a single crushed fragment, 5 × 7 mm in size. It is a very thin shell, blac glossy, corneous or chitinous, and flexible, whose surface is ornamented wit close-set, circular, flat, very low nodes strictly arranged in lines. Zone *Agnostus pisiformis*. Locality unknown.
A. H. Westergård

**Ödum, H.:** De geologiska resultaten från borrningarna vid Höllviken. Del The macro-fossils of the Upper Cretaceous. — Sthlm, S. G. U. Ser. C. N: 527 [= Årsb. 46 (1952), N:o 3] 1953. 37 pp. 4 plates. — The macro-fossi occurring in beds of Emscherian — Maastrichtian age in cores obtained fro two deep wells drilled at Höllviksnäs, S. W. Scania, during 1941—44, a lescribed. The fauna recorded comprises 12 species of brachiopods, 30 lamellibranchs, 12 cephalopods, 2 cirripedes, and in addition a number of not closely leterminable forms. There is also a chapter on stratigraphy, including general emarks, the stratigraphy of the Höllviken cores, and linguistic remarks.

G. Regnéll

## Géologie quaternaire:

### Dépôts et phénomènes glacials

**Ahlmann, H. W:son:** Glacier variations and climatic fluctuations. — Bowman Memorial Lectures Ser. 3. The American Geographical Society, New York 1953. V + 51 pp., 11 text-figs., 4 plates.

**Asklund, B.:** Några kvartärgeologiska iakttagelser i Ljusnans vattenområde Some observations on the Quaternary geology in the valley of the river Ljusnan). — Sthlm, G. F. F. Bd 75, 1953. p. 120, disc. Thorslund, Erdtman, p. 120—121.

**Bergdahl, Arvid:** Israndsbildningar i östra Syd- och Mellansverige med särskild hänsyn till åsarna (Marginal deposits in south-eastern Sweden with special reference to the oses). — Medd. fr. Lunds Univ. Geogr. Inst. Avh. XXIII. 208 pp., 88 text-figs., English summary pp. 189—201. Diss. Lund 1953. — The glacio-morphological phenomena of the Linderöd Range, the Vissefjärda-Karlslunda moraine belt, the Närke plain, the Northern Kilsbergen Range, and the Gävle district are described. The different types of oses are discussed. In the earlier much discussed Gävle district the author distinguishes three different systems of striae. The oldest ice movement was from NW, then there was a movement from NE and the last ice again came from NW.

Jan Lundqvist

**Bergdahl, Arvid:** Marginal deposits in south-eastern Sweden with special reference to the oses. — Lund studies in geography. Ser. A. Physical geography No. 4. 24 pp. 18 text-figs. 1 plate. Lund 1953. — See above.

**Bergström, Erik:** Som glaciolog på Ruwenzori (As glaciologist on Ruwenzori). — Sthlm, Ymer, Årg. 73, 1953, pp. 1—23, 10 text-figs. English summary pp. 22—23.

**Björnsson, Sven:** Drumlinbildningar i Sommen—Åsunden-området (Drumlins in the region of Sommen and Åsunden, South-East Sweden). — Lund, Svensk Geogr. Årsb. Årg. 29, 1953, pp. 104—126, 13 text-figs. English summary p. 126. — Description of some drumlins from the district. Author is of the opinion that lee-side drumlins are formed beneath the advancing ice at a high pressure. If the ice pressure and the velocity of the movement is diminishing, the deposition of material takes place on the stoss side. Comparisons are made with other drumlin regions in Southern Sweden.

R. Sandegren

**Hjulström, Filip:** På expedition till isländska sandurfält 1951 och 1952 (An expedition to Icelandic sandur fields in 1951 and 1952). — Sthlm, Ymer, Årg. 73, 1953, pp. 161—191, 21 text-figs. English summary pp. 190—191.

**Hoinkes, H.:** Wärmeumsatz und Ablation auf Alpengletschern. II. Hornkees (Zillertaler Alpen), September 1951. — Sthlm, Geogr. ann. Årg. XXXV, 1953, S. 116—140, 6 Textfig. English summary S. 139.

**Hoppe, Gunnar:** Några iakttagelser vid isländska jöklar sommaren 1952 (Some observations on Icelandic glaciers during the summer of 1952). — Sthlm, Ymer, Årg. 73, 1953, pp. 241—265, 24 text-figs. English summary p. 265.

**Hoppe, Gunnar** och **Schytt, Valter:** Some observations on fluted moraine surfaces. — Sthlm, Geogr. Ann. Årg. XXXV, 1953, pp. 105—115, 8 text-figs. — Observations in Iceland (Hoppe) and Kebnekaise (Schytt) indicate that the ridges of the moraine surface are formed by the weight of the ice, pressing moraine material up into crevasses in the lee of boulders. This happens behind the zone where the winter temperatures extend through the ice into the ground moraine.
Jan Lundqvist

**Kautsky, Gunnar:** Eine von einem Gletscher gefurchte Moräne. — Sthlm. G. F. F. Bd 75, 1953, S. 490—492, 2 Textfig. — In der Grundmoräne des Gletschers Ålmajalosjägna (Sulitelmagebiet) wurden in der Bewegungsrichtung des Gletschers verlaufende, parallele Furchen beobachtet. Die veröffentlichten Bilder zeigen deutlich, dass die Furchung der Moräne durch den Transport grosser Steinblöcke während des letzten Eisvorstosses hervorgerufen ist. Am Ende einiger Furchen liegen nämlich grosse Blöcke, die einen kleinen Moränwall vor sich aufgetürmt haben.
G. Kautsky

**Lawrence, Donald B.** and **Elson, John A.:** Periodicity of deglaciation in North America sine the late Wisconsin maximum. — Sthlm, Geogr. ann. Årg. XXXV, 1953, pp. 81—104, 6 text-figs.

**Lundqvist, Jan:** Märgelns västgräns i Mälarlandskapen (The western limit of the Glacial marl in the district of Lake Mälaren, Central Sweden). — Sthlm, G. F. F. Bd 75, 1953, pp. 272—276, 1 text-fig. English abstract p. 272. — The map shows all observations of lime content in Glacial clay around Lake Mälaren. The marl forms characteristic lobes which are quite independent of the topography. Accordingly there has been a strong current westwards in front of the ice. This has probably caused an opposite current of brine, which may explain the irregular varves of the clay in the district.
Author's abstract

**Nilsson, Erik:** Om södra Sveriges senkvartära historia (On the Late Quaternary history of southern Sweden). — Sthlm, G. F. F. Bd 75, 1953, pp. 155—246, 35 text-figs., 3 plates. English summary pp. 234—237. — A great number of shore line observations in Southern and Middle Sweden are plotted in a series of diagrams, showing a regular land-upheaval and tilting of the ancient beaches. The Baltic stages can be interpretated thus:

1. Baltic ice dammed lake.
   a. Older stages with outlets towards the west to Kattegat.
   b. Younger stages with outlets through Öresund and towards the White Sea.
2. Yoldia and Rhabdonema Sea with connexion between the Baltic and the North Sea through Middle Sweden.

3. Ancylus lake with outlets through the »Svea River» (Middle Sweden) and Öresund.
4. Litorina Sea with free connexion through Öresund and the Belts. Maps of the Baltic stages are given. E. Fromm

**Schytt, Valter:** Die norwegisch-britisch-schwedische Antarktisexpedition 949 bis 1952. — Berlin, Die Erde, 1953, S. 179—194, 3 Fig., 7 Abb., 1 Karte.

**Schytt, Valter:** The Norwegian—British -Swedish Antarctic expedition, 949—52. I. Summary of the glaciological work. Preliminary report — Camridge, Journ. of Glaciology, Vol. 2, 1953, pp. 204—205.

**Wenner, Carl-Gösta:** Fjäräs bräcka med Lygnern. Drama i fyra akter The Fjäras bräcka and lake Lygnern. Drama in four acts). — Natur i Halland, p. 378—386, 6 text-figs. Göteborg 1952. — See abstract in these transactions, ol. 74, 1952, p. 418.

**Ängeby, O.:** Några kvartärgeologiska iakttagelser från Faxälvens övre lodområde (Some observations concerning the Quaternary geology in the alley of the Faxe River, Northern Sweden). — Sthlm, G. F. F. Bd 75, 1953, p. 501—509, 4 text-figs. English abstract p. 501. — Observations conerning glacifluvial deposits, the highest shore line, ice dammed lakes and ilting, due to land elevation. E. Fromm

## Géochronologie

**Antevs, Ernst:** Geochronology of the deglacial and neothermal ages. — ourn. of Geol. Vol. 61, pp. 195—230, 4 text-figs. Chicago 1953.

**De Geer, Ebba Hult:** La varve zéro et les drainages successifs finaux du rand lac de barrage central du Jämtland. — Cahiers Géologique de Thoiry o 20 Septembre 1953, pp. 169—184, 8 text-figs. Also as Data 85 fr. Stockolms Högskolas Geokronologiska Institut. — In the Ragunda Valley two ifferent drainage varves have formerly been interpretated as the zero varve f the geochronological Time-Scale of Gerard De Geer. E. Fromm

**Fromm, Erik:** Nya C14-dateringar av Allerödtiden. (New $C^{14}$-datings of ie Allerød period). — Sthlm, G. F. F. Bd 75, 1953, p. 403. — A review of cent papers in »Science» etc. New, controlled $C^{14}$-datings of the late glacial ages in Northern Europe practically coincide with datings through varve ronology etc. E. Fromm

**Kullenberg, B.:** Absolute chronology of deep-sea sediments and the depotion of clay on the Ocean floor. — Sthlm, Tellus, Vol. 5, 1953, pp. 302—305. An absolute chronology of deep-sea sediments on the basis of the accumution of $TiO_2$ presupposes the rate of accumulation of clay to be tolerably nstant with regard to time. It is here asserted that this condition is not lfilled, because 1) the supply of fine terrigeneous matter to offshore waters ll be appreciably affected by climatic changes, 2) The total amount of fine rrigeneous matter carried in suspension by sea water is deposited in about 0 years, which is a small fraction of a climatic cycle, and, consequently, the amount of fine terrigeneous matter present in the sea is insufficient to t as a buffer against the variations of the supply, on account of which these riations will be reflected by almost equally great variations of the rate of cumulation. Author's abstract

## Variations de niveau

**Alin, Johan:** Stenåldersforskningen i Bohuslän (Researches concerning the stone age in Bohuslän). — 68 pp. Göteborg 1953. — An introduction to a comprehensive archaeological paper on the stone age in the province of Bohuslän, Western Sweden. It gives *i. a.* an account of the geological history of the district during Late Glacial and Post Glacial times, especially concerning the complicated changes of level, which are due to the upheaval of land after the last glaciation and to the contemporaneous rise of sea level, owing to the melting away of the land ices all over the world. These two factors cause alternating regression and transgression in the southern part of the district. The changes of level are of decisive importance for the distribution of the prehistoric habitation. R. Sandegren

**Björsjö, Nils:** Bohussunden och den senglaciala landhöjningen med någr kartor över fördelningen mellan land och hav i Bohuslän under senglacial tid (The sounds of Bohuslän and the Late Glacial upheaval of land, with som maps showing the distribution of land and sea in Bohuslän during the Lat Glacial period). — Göteborgs K. Vet.- o. Vitt.-Samh. Handl. 6 F. Ser. B. B 6. N:o 8. 25 pp. 9 text-figs. English summary pp. 24—25. Göteborg 1953. Also as: Medd. fr. Göteborgs Högskolas Geografiska Institution 38.

**Fromm, Erik:** Om strandlinjerna i södra Östersjön under senglacial tid (The shore lines in the Southern Baltic in Late Glacial times). — Sthlm, G. F. F. Bd 75, 1953, p. 410. — Some critical remarks about the lowest. submarine Yoldia and Rhabdonema Stages in the Southern Baltic (Erik Nilsson). E. Fromm

**Hela, Ilmo:** A study of land upheaval at the Finnish coast. — H:fors. Havsforskn:inst. Skr. N:o 158. Also as: Fennia 76, No 5. 1953. 38 pp. 14 text-figs. — This study is of interest also with regard to the Swedish coast of the Baltic. R. Sandegren

**Lisitzin, Eugenie:** Contribution to the knowledge of the range of sea leve variations in the North Baltic. — H:fors, Havsforskn:inst. Skr. N:o 153, 1952 20 pp. 1 text-fig.

## Biogéologie

**Björsjö, Nils:** Nytt subfossilfynd av val på västkusten (A new find of sub fossil whale on the western coast of Sweden). — Sthlm, G. F. F. Bd 75, 1953 pp. 510—513, 2 text-figs. — Skeletal remains of a whale, probably *Balaen mysticetus* L., have been found in marine gravel 104 m above sea level a Huveröd in the parish of Ucklum, province of Bohuslän. R. Sandegren

**Cleve-Euler, Astrid:** Die Diatomeen von Schweden und Finnland. II Arraphideae, Brachyraphideae. — Sthlm, K. Sv. Vet.-akad. Handl. Ser. 4 Bd 4. N:o 1. 158 S. 35 Tafeln. Uppsala 1953.

**Cleve-Euler, Astrid:** Die Diatomeen von Schweden und Finnland. II Monoraphideae, Biraphideae 1. — Sthlm, K. Sv. Vet.-akad. Handl. Ser. 4 Bd 4 N:o 5. 255 S. 41 Tafeln. Uppsala 1953.

**Erdtman, G.:** Literature on palynology. XVI. — Sthlm, G. F. F. Bd 75, 1953, pp. 17—38.

**Erdtman, G.:** Pollenmorfologien hos de svenska alarterna. (The pollen morphology in the Swedish species of Alnus). — Sthlm, G. F. F. Bd 75, 1953, pp. 397—398, 1 text-fig.

**Erdtman, G.:** On the difference between the pollen grains in Alnus glutinosa and those in Alnus incana. — Sthlm, Sv. Botan. Tidskr. Bd 47, 1953, pp. 449—451, 1 text-fig. Uppsala 1953.

**Fries, Magnus:** A pre-Quaternary pollen found in post-glacial clay mud at Varnhem in Västergötland, Sweden. — Sthlm, G. F. F. Bd 75, 1953, pp. 106—108, 1 text-fig. — The find indicates that pre-Quaternary (perhaps Upper Cretaceous) material is included in the soils of the surroundings of Varnhem.
R. Sandegren

**Hustedt, Friedrich:** Die Systematik der Diatomeen in ihren Beziehungen zur Geologie und Ökologie nebst einer Revision des Halobien-Systems — Sthlm, Svensk Botan. Tidskr. Bd 47, S. 509—519, Uppsala 1953.

**Jimbô, T.:** Palynology in Japan. — Sthlm, G. F. F. Bd 75, 1953, pp. 400—402.

**Lepiksaar, Johannes:** Svenska subfossilfynd av mindre liran, Puffinus puffinus, Brünnich. (Subfossil finds of Puffinus puffinus, Brünnich, in Sweden). — Göteborgs Museum, Årstryck 1949 o. 1950, pp. 144—147, 3 text-figs. Göteborg 1950. — The finds come from the Post Glacial shell bed of Otterön and from the stone age dwelling place of Rotekärrslid, both in the province of Bohuslän. These layers belong to the Litorina period. R. Sandegren

**Lundqvist, G.:** Långspridning av svampsporer (Long-distance spreading of spores of fungi). — Sthlm, G. F. F. Bd 75, 1953, pp. 39—42, 1 text-fig. English abstract p. 39. — Last autumn a great drift of spores of *Chrysomyxa woroninii* was found in Kebnekaise, the highest mountains in Sweden. The author has correlated it with the strong infection of the same parasitic fungus on the *Picea* in the forests of Norrland. An examination of the meteorological situations in the latter part of August indicates that the spore drift with the wind occurred on August 27—28. As the spores must have flown at least 75 km, this little paper is of interest in our studies of the long-distance transport problem in pollen analysis. Author's abstract

**Nilsson, Tage:** Pollenanalys av svämtorv från Vollmon, Jämtland (Pollen analysis of alluvial peat from Vollmon, Jämtland). — Sthlm, G. F. F. Bd 75, 1953, pp. 507—508. — The peat probably dates from the period 1500—6000 B. C.
R. Sandegren

**Olausson, Eric:** En submorän torvbildning i Skåne (A sub-morainic peat layer in Scania). — Sthlm, G. F. F. Bd 75, 1953, pp. 513—514. — By a well digging near the church of Vallkärra a thin layer of peat has been found under 2,7 m boulder clay of Baltic origin, and resting upon gravel. The peat is very poor in pollen and spores, and probably belongs to an interstadial period of the last glaciation.
R. Sandegren

Recommandations faites à la première réunion de la Commission Internationale de la Palynologie. — Sthlm, G. F. F. Bd 75, 1953, pp. 515—516.

**Sandegren, Ragnar:** Interglacialfynd i Ångermanland och Medelpad (Finds of Interglacial deposits in Ångermanland and Medelpad). — Natur i Ångermanland och Medelpad, pp. 32—41, 5 text-figs. Uppsala 1953. — A popular account of the Interglacial deposits in the provinces named. A map shows the location of the Interglacial deposits in Fennoscandia and its environs as well as the finds of mammoth remains hitherto known in Fennoscandia.
R. Sandegren

**Stjernquist, Berta, Nilsson, Tage** and **Nybelin, Orvar:** Some stone age fishing tackle from Scania. — K. Hum. Vetensk. Samf. i Lund Årsber. 1952—1953, IV. pp. 123—148, 13 text-figs. 1 plate. Lund 1953. — The two nets are roughly contemporary and date for certain from zone IV$^{a}$, most probably the middle phase of this zone (approximately the stage between horizons c and d). This means that they are neolithic and belong to either the Dolmen or the Passage Grave Period. The trap must be dated to the later phase of zone V$^{a}$, *i. e.* the end of the Mesolithic.
T. Nilsson's summary

**Wenner, Carl-Gösta:** Investigation into the possibilities of distinguishing the pollen of the various species of Betula in fossil material. — Sthlm. G. F. F. Bd 75, 1953, pp. 367—380, 8 text-figs. — Das Problem besteht in der Frage ob in Nord europa Pollentypen vorhanden sind mit denen die Grösse von Betulapollen verglichen werden kann. Es sind vermessen worden Pollen von Betula, Pinus und Cyperaceae. Das Pollenmaterial war teils von Professor Eneroth, teils neugesammeltes Material aus Nord schweden, sowie spätglaziales Material aus Nord schweden. Nach den Resultaten zu schliessen, glaubt man annehmen zu können, dass das Fossilwerden der Pollen ihre Grösse beeinflusst hat. Verf. hat nicht die verschiedenen Betulaarten durch Messungen ihrer Grösse unterscheiden können.
C. G. Wenner

**van Zinderen Bakker, E. M.:** Palynology in South Africa. — Sthlm, G. F. F. Bd 75, 1953, pp. 398—400.

## Étude des sols et Géologie agricole

**Andersson, Sigvard:** Markfysikaliska undersökningar i odlad jord. II, III, IV och V: Om markens permeabilitet (Physical investigations in cultivated soils, II, III, IV, and V: On soil permeability). — Uppsala, Grundförbättring, Årg. 6, 1953, pp. 28—45, 4 text-figs. Ibid. pp. 74—89, 1 text-fig. Ibid. pp. 160—176, 4 text-figs. Ibid. pp. 217—234, 5 text-figs. — Paper II deals with the fundamental Darcy's law from physical and theoretical points of view. Paper III, IV, and V deal with experimental investigations concerning soil permeability.
Author's summary

**Arrhenius, O.:** Vissa ämnens fördelning i marken i Kopparbergs län (Some minor elements of the soils in the province of Kopparberg, Dalecarlia). — Sthlm, S. G. U. Ser. C. N:o 518 [= Årsb. 44 (1950), N:o 4], 1953. 40 pp., 24 text-figs. English summary pp. 37—40. — The content of $P_2O_5$, Mn, Fe, Cu, V, Ni, Ca and the pH in the subsoil, the arable top soil and natural humus soils are compared. Great differences caused by leaching and precipitation are found. The results are also compared with the chemical composition of the bedrock.
Jan Lundqvist

**Ekström, G.:** Åkermarkens matjordstyper (Cultivated soils. Surface soils). — tlas över Sverige 63—64. pp. 1—6, 2 text-figs. 2 maps. English summary . 6. — The map shows the distribution of the different soils of the arable nd with regard to the mechanical composition (clay- and humus-content c.). With regard to the soil-nomenclature and the methods for soil determinaon the author refers to his paper »Soil Classification in Scandinavia—Finnd, especially in Sweden», Transactions from Fourth International Congress f Soil Science, Amsterdam 1950, Vol. II. G. Ekström

**Mohrén, Erik:** Agrikulturella detaljkartor (Agricultural detail maps). — thlm, IVA 24 (1953): 5. pp. 225—226. — In the different series of maps of e Geological Survey of Sweden the agricultural detail maps is the youngest ne. The index of this series is Ad; the printing scale 1: 20 000. The main istinction between these maps and those of the series Aa in scale 1: 50 000 that, where as the latter ones look upon the soils from a genetical point of iew, the agricultural maps represent the petrological changes of the soils. pecial stress has been put upon the differentiation of the clays. These maps ay be of great use at the valuation of land properties, prospecting of ground ater, searching for clays for brickyards etc. E. Mohrén

**Philipson, Tore:** Boron in plant and soil with special regard to Swedish griculture. — Acta Agricult. Scand. Vol. III: 2, pp. 121—242, 9 text-figs. ppsala 1953.

**Philipson, Tore:** Det regnar bor (It rains boron). — Sthlm, Lantmannen, rg. 37 (64) 1953, p. 536.

**Tamm, Olof:** Hamra revir. Naturbeskrivning, skogstyper (The rangership f Hamra. Physical character and types of forest). — Norrlands Skogsvårdsrb:s Tidskr. 1953, pp. 579—593.

**Wiklander, Lambert:** Bestämning av flockvolym hos lermineral och jordar ome data on floc volumes of different clay fractions). — Uppsala, Grundrbättring, Årg. 6. 1953, pp. 46—54, 2 text-figs. — Describes the technique ed and discusses the significance of floc volumes in relation to clay particle ze and mineralogical composition. Author's summary

## Donnés biographiques

**gvad, Richard:** Nécrologie.

Noe-Nygaard, Arne: Richard Bøgvad 21. November 1897 — 7. August 1952. — Kobenhavn, Naturhist. Tidende, Aarg. 17, 1953, pp. 86—88, 1 portrait.

See also these transactions Vol. 75, 1953, p. 461.

**slie, Steinar:** Nécrologie.

Bugge, Carl: Minnetale over statsgeolog Steinar Foslie. — Det Norske Vidensk.-Akademi i Oslo Årbok 1952, pp. 43—46, 1 portrait.

See also these transactions, Vol. 74, 1952, p. 424, and Vol. 75, 1953, p. 461.

**Hedin, Sven:** Nécrologie.

Nelson, Helge: Sven Hedin. Minnesord vid Sydsvenska Geografiska Sällskapets sammanträde i Malmö den 24 febr. 1953. — Lund, Svensk Geogr. Årsb. Årg. 29, 1953, pp. 136—140, 1 portrait. Deutsche Zusammenfassung p. 140.

See also these transactions Vol. 75, 1953, p. 462.

**Mäkinen, E.:** Nécrologie.

Wickman, F. E.: Eero Mäkinen †. — Sthlm, G. F. F. Bd 75, 1953, p. 527.

**Niggli, Paul:** Nécrologies.

Brandenberger, Ernst: Paul Niggli als Forscher und sein wissenschaftliches Werk. — École Polytechn. Fédérale. Études Litt. Soc. et Économiques. 83. pp. 15—23. Zürich 1953.

Karrer, Paul: Paul Niggli, seine Persönlichkeit und seine Verdienste un die Organisation und Förderung von Forschung und Lehre. — Ibid. pp. 5—14, 1 portrait.

Wickman, F. E.: Paul Niggli †. — Sthlm, G. F. F. Bd 75, 1953, p. 122

**Wallerius, Johan Gottschalk:** Autobiography.

Zenzén, Nils: Johan Gottschalk Wallerius' självbiografi (The autobiography of Johan Gottschalk Wallerius). — Lychnos 1953, pp. 235—259 1 portrait. English summary pp. 258—259. Uppsala 1954.

**Warburg, Elsa:** Nécrologie.

Wickman, F. E.: Elsa Marianne Warburg †. — Sthlm, G. F. F. Bd 75 1953, pp. 312—313.

**Westerlund, Erik:** Nécrologie.

Lindroth, Gustaf T.: Bergsingenjör Erik Westerlund 7/10 1879—4/1 1953. — Sthlm, G. F. F. Bd 75, 1953, pp. 497—500, 1 portrait.

**Ygberg, Erik R.:** Nécrologie.

Wickman, F. E.: Erik R. Ygberg †. — Sthlm, G. F. F. Bd 75, 1953, p. 433

## Miscellanées

**Arnborg, Lennart:** The sand-trap. An apparatus for direct measurement o bed load transportation in rivers. — Sthlm, Geogr. ann. Årg. XXXV, 1953 pp. 75—82, 8 text-figs. — By means of photocells the sand-trap measures th migration speed of bed material while disturbing the natural motion of th water as little as possible. The size distribution of the material is obtained b analyzing the content of the trap. Jan Lundqvist

**Bergsten, Karl Erik:** Svensk geografisk bibliografi för år 1952 (Swedis geographical bibliography in 1952). — Lund, Svensk Geogr. Årsb. Årg. 2 1953, pp. 240—260.

**Faegri, Knut:** The pollen-analytic laboratory of the University botanica museum in Bergen. — Sthlm, G. F. F. Bd 75, 1953, pp. 108—112, 2 text-fig

**Kallstenius, Torsten:** Some side-intake soil samplers for sand and gravel. — oyal Swedish Geotechn. Inst. Proceedings No. 7. 35 pp. 18 text-figs. Sthlm 53. — Three main types of samplers are described: 1) Supplementary rts of the sounding device. 2) Samplers, part of which are withdrawn after king each sample. 3) Samplers for taking many samples in one operation.

Jan Lundqvist

**Kjellberg, Sven T.:** Ur lerans och stenkolets kulturhistoria (Clay and coal human civilization). — Stenkol och lera. Skildringar kring Höganäsbolagets h dess föregångares verksamhet utgivna av Höganäs-Billesholms AB. 1, . 27—72, 26 text-figs. Uppsala 1953. — The role played by clay and coal human economy from the dawn of culture up to present time is illustrated this rapid survey.

G. Regnéll

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From the author's summary

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**Weimarck, Henning:** Geologiskt intressanta naturminnen (Natural monuments of geological interest in Scania). — Lund, Skånes natur XL, 1953. pp. 115—118, 1 text-fig.

**Wickman, F. E.:** Hur står det till med geologiundervisningen i folkskolan? (How is geology teached in the elementary schools?) — Sthlm, G. F. F. Bd 75, 1953, p. 121. — It is emphasized that geology is completely neglected in Swedish elementary schools. F. E. Wickman

**Åhman, Erik:** Om några magnetstenar från 1700-talet (On some loadstones from the eighteenth century). — Sthlm, G. F. F. Bd 75, 1953, pp. 396—397. 1 text-fig. — Torbern Bergman who was a Professor of Chemistry in Uppsala in 1767—84 had a collection of models and of this are still preserved in the Geological Department of the University of Uppsala 3 natural magnets which are armed and are hanging on stands. E. Åhman

# Bemerkungen zu zwei morpho-tektonischen Arbeiten im Präkambrium Südschwedens

Von

HANS J. KOARK

In den neulich erschienenen Arbeiten von S. BEHRENS (1953) über e nordwestschonischen Urgebirgsrücken und I. LARSSON (1954) er das Grundgebirge des westlichen Blekinge wurden grundgebirgs- ktonische und -morphologische Studien vorgelegt, die sich mehr in agestellung als Methodik an ERIK LJUNGNER's klassische Arbeiten Bohusgranit anlehnen. Gleichzeitig wurde damit auch das tektonische espräch über südfennoskandische Probleme wieder aufgenommen, s von S. v. BUBNOFF und seinen Greifswalder Schülern mit Beginn r dreissiger Jahre in Gang kam und während des 2. Weltkrieges eine hl zeitlich bedingte Einstellung erfuhr.[1]

Die beiden schwedischen Abhandlungen sind am geographischen stitut der Universität Lund erschienen und ihre Authoren Geographen. as verwundert nicht weiter, wenn man weiss, dass der so plötzlich Frühjahr 1954 verstorbene Professor ERIK LJUNGNER ihr Lehrer d Wegbereiter war. Obwohl mit seiner Arbeitsrichtung selbst Schule dend, machte er BEHRENS und LARSSON auf die modernen SANDER' nen Gefügemethoden aufmerksam und gab ihnen jedmögliche Unter- itzung die zur Erlernung und Weiterbetreibung derselben notwendig r, was übrigens der Eingeweihte gern in den Abhandlungen gelesen tte. Ihre dem Sinne nach gleichlautenden Fragestellungen sind geo- gisch und zum grössten Teil auch mit geologischen Methoden bear- itet und beantwortet. Die Verfasser hatten sich zur Aufgabe gestellt, s »Gefügerelief» (SANDER 1948), also die Abhängigkeit von tekto- chem und Korngefüge (inkl. mineralogischer Zusammensetzung) f die morphologische Formgestaltung ihrer Gebiete zu untersuchen. ide verwendeten zur Schaffung der tektonischen Grundlagen — wie on erwähnt — die von B. SANDER letztmalig 1948/50 ausführlich rgestellten gefügekundlichen Methoden, wobei Larsson die tekto-

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Neue Detailstudien aus der Zeit nach dem Kriege fehlen, Übersichten finden sich S. BUBNOFF: Fennosarmatia. Bln. 1952 und von demselben Verfasser in »Über die länder Erdnaht» in Geol. Rundschau, Cloos-Gedächtnisband 1953.

Ein Vergleich der grosstektonischen Resultate vorliegend besprochener Abhandlungen denen der Greifswalder Auffassungen ist in Vorbereitung.

nische Analyse noch durch petrographische Korngefügestudien ergänzte.

Zur Bearbeitung grosstektonischer Fragen wurden sowohl in Bleking als auch in Schonen Schwerkraftmessungen hinzugezogen. Geographisch betont sind die morphometrischen Analysen von Behrens, die inzwischen von Fachseite streifend kritisch besprochen wurden (Rudberg 1954: S. 135 ff).

Die Tatsache, dass die selektive Oberflächengestaltung im Meterbereich vor allem die Tektonik (einschl. Korngefüge) und das Festigkeitsverhalten der Gesteine abbildet ist seit langem erkannt und beschrieben. In diesem Sinne brachten beide Arbeiten auch nicht prinzipiell Neues, sondern bestätigten nur mit zahlreichen Beispielen dies Erkenntnis. Das nichtselektive Relief blieb unbehandelt, ein Versäumnis gleich dem, das Gefügerelief zu übersehen. Weder Behrens noch Larsson versuchen den Einfluss der richtungskonstante präparierenden Einflüsse (Wasser und Eis) auf die Reliefgestaltun zu untersuchen; Behrens mit ausdrücklicher Distanzierung von de Ahlmann'schen Auffassung, dass man z. B. erst die Abrasionsprozess als solche studieren möge und erst dann den durch sie hervorgebrachte Formenschatz, was nicht hätte ausschliessen sollen, es danach zu tun Es sei nicht verschwiegen, dass ein solcher Versuch für die Grotten au Kullaberg als Abrasionsphänomene vorliegt.

Behrens' Einteilung in Ganggrotten, Kluftgrotten und s-Grotte ist für die zwei erstgenannten inbezug auf geologisch-tektonische Erscheinungen gewählt — ohne Aussage über deren Form: die letzter hingegen ist formbeschreibend, nämlich mit grösster Ausstreckung parallel s. Ein Gang hat neben dem tektonischem Faktor: seiner quergreifenden Raumschaffung, auch einen intrusionsmechanisch-petrographischen: die Füllung. Die Kluft hingegen ist nur ein tektonische Element. Nun kann ja eine »Ganggrotte» als Einbuchtung an Stelle gangförmiger Eruptiva ebenso eine »Kluftgrotte» sein, nämlich dann wenn die spezielle Verklüftung des Ganggesteines (z. B. Kontraktionsklüfte) dafür verantwortlich gemacht werden kann. Der Gang bildet dann einschliesslich seiner Salbänder eine mechanische Festigkeitsanisotropie für den betrachteten Gesamtbereich. Zum anderen kan die Höhlenbildung auf nicht tektonisch herabgesetztem Festigkeitsverhalten gegenüber dem umgebenden Material beruhen, wie z. B. niedere Schleif- und Schlaghärte, schwächere Kornbindung, chemisch leichtere Löslichkeit, usw. Beides kann sich und wird sich meist unkontrollierbar überlagern. — Aber auch die »s-Grotte» kann eine »Kluftgrotte» sein, dann wenn es sich an Stelle prä- bis parakristalliner s-Flächen um postkristalline s-Fugen handelt!

Iieraus scheint ersichtlich, dass zu einer Typisierung der Grotten im
HRENS'schen Sinne für jede Einzelne eine eingehende petrographisch-
tonische Untersuchung zu fordern wäre, mit Abwägung des ge-
seitigen Anteiles obenerwähnter Faktoren (vgl. »Ganggrotte»).
nn, dann wäre dies nur unter grossen Mühen durchführbar. Sollte
n nicht auch hier, wie bei jeder Systematisierung, sich fern von
etischen Deutungen halten und eine deskriptive Methode wählen.
nnte man nicht bei Typisierung der Abrasionsgrotten ihre Raummasse
geben oder in ein Parameterverhältnis umsetzen, das zusammen mit
Orientierung der Grotte zu den Erdkoordinaten und auf das in der
dernen Tektonik gebräuchliche abc-Kreuz bezogen wird. Nur so
ren statistische Studien über räumliche Verteilung an der Küste,
entierung im Achsenkreuz und zum richtungskonstantem Anfall
Wogen obigerweise typisierter Grotten möglich.

st der Hauptanteil der von BEHRENS beschriebenen Formenskulptur
Küstensaum von Kullaberg eine Folge der Abrasion, so scheint der
herrschende Typ in Blekinge bis auf die äussersten Scheren hinaus
zial entstanden zu sein. Dieser Unterschied liegt wohl zuerst in der
gleichen Dichte und Richtungstendenz der postkristallinen Kluft-
ze und im prä- bis parakristallinen Gesteinsgefüge begründet. Wie
on erwähnt, hatte LARSSON sich nicht zur Aufgabe gestellt, die
rtäre Eisschliffwirkung aus dem vorgefundenem Relief zu rekonstru-
n. Schade, hier hätten sich wertvolle Konfrontationsmöglichkeiten
den Resultaten BUBNOFF's (1934) in ähnlichem geologisch-petro-
phischen Milieu und an gleichartig, wie gleichgerichteten Spalten-
rn auf Bornholm ergeben.

rgleiche die Richtungen der in CALLISEN's Karte (1932) eingezeichneten Spaltentäler
jenen von Blekinge, die aus dem Isohypsenverlauf der LARSSON'schen Karte (Fig.
und HABETHA's (1936) Diagrammen zu entnehmen sind. Der »streifige Granit» CALLI-
s oder wie ihn BUBNOFF nennt: »Hauptgranit» — ist mit dem Küstengneis Blekinges,
Hammergranit auf Bornholm mit dem Spinkamålatyp und der Svaneckegranit mit
Karlshamngranit in Blekinge zu vergleichen, worauf bei anderer Gelegenheit noch
ckzukommen sei.

olgend wird man ersehen, dass BUBNOFF's Studien sehr wichtige
ultate für die selektive Präparation des Gefügereliefs durch richtungs-
stante Eisströme beibrachten.

etreffend der Spaltentäler fragt nun BUBNOFF, 1. warum nur be-
mte Kluftrichtungen ausgeräumt wurden und andere gleich mar-
te, wie z. B. die E—W Klüfte nicht? 2. Warum fehlt im Sediment-
et im Süden der Insel dieser Taltyp? 3. Inwieweit ist die mechanische
räumung der Spalten durch das Eis zu erklären? 4. Warum wurden
einer Menge parallel verlaufender Spalten gerade jene heute
effbaren zu Spalten erweitert?

Bei den Punkten 1 und 2 kommt Bubnoff zu dem Resultat, das für das nördlich gelegene Kristallingebiet die von NNO kommende Eismassen die vorgezeichneten mechanischen Inhomogenitäten (N— Klüfte) parallel trafen und somit beste Angriffswinkel für deren Ausräumung vorfanden. Im tieferliegenden südlichen Sedimentgebiet de Insel liegt die Eisrichtung verändert mit OSO—WNW. Das sie hier nich gleichen Effekt zeigt, bezieht Bubnoff einesteils auf das nicht s konstant entwickelte O—W Kluftsystem in diesem Bereich und di besonderen Drainageverhältnisse.

Bei Besprechung der 3. Frage wird die Assymmetrie der Talquar schnitte behandelt. So wird konstatiert, dass in der Mehrzahl di Westhänge der Täler steiler als jene der Osthänge sind. Diese allgemeine Gesetzmässigkeit wird mit der Art der Ausräumung in Zusammenhang gebracht, wobei als Komponenten einmal das deutlich Osteinfallen der N—S Klüfte und andererseits der spitze Auftreffwinkel der Eisrichtung aus NNE angesehen werden.

Im letzten Punkt lautet die Antwort: die Auswahl der Spaltentäle ist auf solche N—S Kluftzonen beschränkt, die sich als besonders eng klüftige Inhomogenitätsgebiete erwiesen.

Der Leser wird aus dieser kurzen Zusammenstellung von Frage und Antworten entnommen haben, dass für Larsson durch die Bu noff'sche Arbeit im benachbarten und verwandtem Gebiet selte günstige Anknüpfungspunkte gegeben gewesen wären.

Es war eigentlich nicht beabsichtigt so weit morphologische Frage zu diskutieren. Vielmehr war es, der dem Referenten näherliegend gefügekundlich-tektonische Inhalt beider Schriften, der beleuchte werden soll.

## Das Flächen- und Achsengefüge, inkl. nach kristalline Flächenverstellungen

Vorstehend überschriebenes Kapitel soll die den jeweilig letzte kennbaren Hauptkristallisationen (abschliessende Bildung der Haup gemengteile, also z. B. nicht Phyllosilikate als Kluftbelag), zuordenbare Gefüge wie s-Flächen, B-Achsen, usw. behandeln. Ausserdem werde die nachkristallinen Flächenverstellungen hier erwähnt, da es durcha nicht sicher ist, dass sie nur in Zusammenhang mit den späteren Kluf bildungsphasen entstanden (vgl. Larsson). Die Fugengefüge sollen i einem späteren Abschnitt zu Worte kommen. Diese Einteilung is auch mehr oder minder bei Behrens und Larsson gebraucht, wen auch unter anderer Bezeichnung. So rangiert die Behandlung der s B bei Behrens unter der Benennung »Gefügeuntersuchung», diejeni

Klüfte jedoch als »tektonische Untersuchung». Bekanntlich sind s
l B ebenso tektonische Phänomene wie die Klüfte und Letztere
alle Raumdaten (einschliesslich skalare) zum Gefüge zählend!

Kullaberg — Hallands Väderö — Hallandsåsen.

Regional gesehen hatte BEHRENS keine Berührungspunkte zu frü-
en Gefügearbeiten. Die petrographische Unterlage war für Kulla-
g durch HENNIG's monographische Behandlung gegeben, die trotz
es hohen Alters von über 50 Jahren — wenigstens für den deskrip-
en Teil — noch eine sehr gute Übersicht erteilt. Für die übrigen
diengebiete fehlten ähnliche petrographische Beschreibungen. Der
fasser zitierte hier die seit altersher gebräuchliche Auffassung, dass
Gesteine Glieder der Südwestschwedischen Järngneis (Eisengneis-)-
gion, eines Komplexes stark variierender Gneise, sind. Die Gesteine
Kullaberg und Hovshallar gehören — nach Beobachtungen des
ferenten — zu einer Serie hochkristalliner Metamorphite, die nach
füge und Mineralbestand der Granulitfacies zuordenbar ist. Das Auf-
ten von mehr basischen, charnockitischen Gliedern in ihr leitet zu
rallelen in der Zone von Varberg und anderen Vorkommen am
westschwedischen Küstensaum.

Petrographische Kartierungen wurden von BEHRENS insofern aus-
ührt, indem die Verbreitung von Amphibolit, Diabas und Kullait
Kullaberg: Amphibolit und Diabas auf Hallands Väderö in Iso-
senkarten eingetragen wurde. Die verschiedenen Gneistypen blieben
och unberücksichtigt.

Alle Gefügearbeiten beschränken sich auf Untersuchungen im Be-
h Handstück — Profil, also nicht im Korngefüge. Der Hinweis des
fassers, dass für seine Fragestellungen die Korngefügeanalyse einen
ötigen Umweg dargestellt hätte, ist diskutierbar. Wenn die Be-
ndung, dass das Korngefüge im allgemeinen mit dem tektonischem
üge korrelativ ist, auch nicht unrichtig ist, so wurde doch mittels
ser Mutmassung ein wichtiger Weg zu noch tiefergreifenden Erkennt-
sen verschlossen. Die Tragweite solcher Untersuchungen ist nicht im
hinein festlegbar. Dass Korngefügestudien selbst zur Beantwortung
phologischer Fragen beitragen können, zeigt LARSSON. Durch
ngefügeanalysen wurde hier ein erosiv tiefgeschnittener isoklinaler
tenbau rekonstruiert, dessen verschiedene Tektonittypen auch den
phologischen Kleinformen ein Einteilungsprinzip gaben.

EHRENS' Untersuchungen beschränkten sich also auf die Kom-
smessung und statistische Behandlung des Achsen- und Flächen-
ges von Kullaberg und Hallands Väderö, sowohl vereinzelter
sungen auf Hallandsåsen. Die statistische Behandlung ging dabei

darauf aus, für die Orientierung von s und B jeweilige Homogenitätsbereiche abzugrenzen und miteinander zu konfrontieren.

Die Resultate kurz zusammengefasst sind: Auf Kullaberg Umschwenken der Streichrichtungen für s vom NNW-Teil der Halbinsel mit ca N—S bis NNW—SSE zum östlichen Teil des Gebietes bei Arild mit NE—SW bis ENE—WSW. Einfallen von s durchschnittlich zwischen 25 und 50° gegen W bis N mit dem Umschwenken mitgehend. Zeigen sich in den westlichen Bereichen mehr homogene Einfallwinkel, so werden sie mit Annäherung gegen E mehr und mehr unruhig. — Die Richtung der B ist im allgemeinen ziemlich konstant NW—SE bis NNW—SSE. Ihr Einfallwinkel korreliert mit den Schwankungen jenes der s, liegt also auch zwischen 25 und 50°. Sich kreuzende B wurden beobachtet, aber nicht ausgewertet.

Die Auswahl der Homogenitätsbereiche geschah ausserdem aufgrund des Verhältnisses von B und $\beta$ ($\beta$ ist die Häufung der Schnittlinien aller s-Flächen eines Bereiches und ist ein Mass für die in diesem Bereich herrschende Tautozonalität der s-Flächen (SANDER 1940)). Es zeigte sich, dass auf Kullaberg B und $\beta$ vorherrschend gleichgerichtet, d. h. die Bildung von s und B oder Prägung von B auf s syntektonisch sind. Für einzelne Bereiche war dies nicht gegeben. Hier wurden spätere nach der Achsenprägung erfolgte Flächenverstellungen ermittelt. Sie fanden sich im Gneis besonders in Nähe von Amphibolitvorkommen. Die Amphibolite waren natürlich unter allen tektonischen Prozessen Festigkeitsanisotropien im homogenen Gneispaket, deren Grenzflächenbereiche in Nachwehen zur syntektonischen s und B Orientierung für lokale Verstellungen besonders labil waren. Letztes ist Meinung des Referenten, begründet auf der Tatsache, dass $B \wedge \beta$ nur im Zusammenhang mit Amphiboliten, aber nicht mit den jüngeren Diabas- und Kullaitgängen, sowie zu deren Raumschaffung führenden Kluftphasen in Verbindung steht.

Der gleiche Arbeitsgang wurde auf Hallands Väderö und dem Hallandsåsen angewendet. Methodische oder allgemeingültige neue Gesichtspunkte ergaben sich dort nicht. Von regionalem Interesse jedoch ist, dass hier die Achsenprägung bereits im Meter- bis Meterzehnerbereich gekrümmte Gefüge vorfand.

Die statistische Behandlung der Messdaten wurde von BEHRENS mit grosser Energie durchgeführt. Mengen von diagrammatischen Darstellungen, Mittelwertsberechnungen, usw. zeugen für intensive Durcharbeitung. Allerdings waren damit keine über die andrerorts geübten Gefügemethoden hinausreichende Schlüsse möglich. Was der Geologe hingegen bedauert ist, dass BEHRENS hier auf halbem Wege Halt machte und nicht sein umfangreiches Material durch »konstruk ve Rückformungen» voll ausschöpfte. Dadurch hätten sich itere Einblicke in die tektonische Entwicklung ergeben könn.

Südwest-Blekinge.

Mit der Übersicht über frühere geologische Arbeiten legt Larsson ich eine modifizierte geologische Übersichtskarte über SW-Blekinge id die angrenzenden Teile von Schonen vor. Der dabei von Larsson ologisch-morphologisch behandelte Anteil beträgt ca. 1/10 des Karibereiches.

Prinzipiell gilt für alle Karten der Arbeit: Die Gefügeausbildung der steine und deren Orientierung im Raum soll möglichst in der Karte m Ausdruck kommen. Gesteine mit s sind durch richtungsbetonte gnaturen, die in ihrer Orientierung den Daten in der Natur entsprechen llen, zu kennzeichnen. Gefügeisotrop wirkende Gesteine sind durch trop wirkende Signaturen darzustellen.

In Fig. 2 bekommt der Kartenleser unwillkürlich den Eindruck, als der Hälleflintagneis, Granitgneis, Muskowitquarzit und Küstengneis, e ja alle parallelstruiert sind, isotrope Gesteine sind. Andererseits ire aus den in derselben Karte E—W gerichteten Signaturen des alengneises, Gneisgranites, Gneisgranitmigmatites und Amphibolites e Folgerung möglich, dass diese Gesteine auch in der Natur diese ige im Raum einnehmen, was natürlich nicht der Fall ist.

Es sollte angestrebt werden, ein und denselben Gestein in allen Karten id Profilen wenigstens der gleichen Abhandlung einheitliche Signaren zu geben. In Fig. 13 kennzeichnet der Verfasser den Küstengneis r gleiche Lokale andersartig als in Fig. 2 und 40.

Die Petrographie, das Achsen-, Flächen- und Korngefüge wurden ierseits für das Gebiet des Küstengneises und andererseits für Gneisinit und Karlshamngranit getrennt behandelt. Für die Gesteinsschreibungen greift der Verfasser hauptsächlich auf die Arbeiten von Norin (1936) zurück. Auch andere Verfasser sind kurz zitiert. Die rschiedenen älteren Auffassungen über das Verhältnis des Västanådes zum Küstengneis sind nur angedeutet.

R. Norin unterscheidet aufgrund eingehender petrographischer udien zwischen kalifeldspatreichen-biotitarmen und biotitreichenlifeldspatarmen Varietäten des Küstengneises. Diese Typisierung schah mittels planimetrischer Dünnschliffanalysen. Larsson hinweist i Besprechung derselben, dass bei der angewandten Integrationsmeode nicht auf die Anisotropie des Gneises Rücksicht genommen worden und somit Fehler möglich sind. Jedoch findet sich keine Auskunft über das »w i e« der Fehlerquelle und man muss annehmen, dass auf dreidimensionale Schnitte (⊥ a, ⊥ b, ⊥ c des Gefüges) hingezielt wird. Hier haben jedoch eine Reihe Arbeiten den Erweis erbracht, dass der Unterschied zwischen Schnitten ⊥ und // B für alle auch noch so oblongen und geregelten Gemengteile in Werten resultiert, die innerhalb des Ungenauigkeitsgrades planimetrischer Analysen mit ± 2 % liegen. Das stimmt auch mit CHAYES Überlegungen überein, wonach Fehler in Gefügeschnitten verschiedener Tropie durch entsprechend zugeordnet lange Messtrecken verhindert werden. Es ist natürlich selbstklar, dass man Schnitte nicht in die monomineralischen s eines stoffverschiedenen Lagengefüges legt.

Auch kommt es darauf an, welche Fragen man mittels des Resultates einer planimetrischen Analyse beantworten will. Ist es so einfach wie im vorliegendem Fall, dass man entweder Kalifeldspat- oder Biotitreichtum konstatiert, so ist die Integrationsmethode über jede Fehlermöglichkeit erhaben.

Vom Standpunkt des Petrographen kann eine Typisierung von Gesteinen aufgrund des Kalifeldspatgehaltes insofern problematisch werden, als Kalifeldspat sehr gerne als eines der letzten Kristallisationsprodukte von Regionalmetamorphosen auftritt. Er ist dann meist aus zirkulierenden kalireichen Lösungen entstanden und seine Platznahme oft so unberechenbar, dass er für stratigraphische Zwecke als Leitmineral ungeeignet ist.

Das Flächen- und Achsengefüge im Küstengneis wird nach üblicher — auch von BEHRENS angewandter — SANDER-Methode untersucht und dargestellt. Die über den gesamten Untersuchungsbereich ± flach gegen N einfallenden B zeigen verschieden kräftige Ausbildung, die mit derjenigen von s korrespondiert. Hinsichtlich dieser Beobachtung ausgeführte Korngefügestudien lassen den Verfasser in Tektonittypen einteilen, wo einerseits B deutlicher als s ist = als BS-Tektonit bezeichnet, andererseits s deutlicher als B = SB-Tektonit benannt. Ihre jeweilige Verbreitung für den Küstengneis zeigt eine Übersichtskarte (Fig. 18). Sie verteilen sich auf NNE—WSW streichende Homogenitätsstreifen, die raumrhytmisch BS : SB in ENE—WSW-Richtung gestaffelt sind. Auf Grund dieser wechselweisen Anordnung von B und s — Tektoniten rekonstruiert LARSSON einen für den Küstengneis isoklinalen Faltenbau. Eine tektonische Bauform, die seit langem für steilstehende Strukturen im Präkambrium diskutiert, hier jedoch erstmals mit beweiskräftigen Gefügemitteln im tief erodierten Milieu bestätigt wird.

Mittels der tektonischen Analyse beweist der Verfasser, dass das Gebiet mit E—W strain gefaltet wurde. Er stellt sich somit in Gegensatz zu ASKLUND (N—S strain) und R. NORIN (NE—SW strain). Dadurch wird das Gebiet nicht mehr zum svekofennidischen, sondern zum gotokarelidischen Orogen gerechnet.

Die Arbeiten im östlichen Teilbereich (um und östlich Karlshamn) galten hauptsächlich dem Gneisgranit, Karlshamngranit und nur ganz im Osten einem Streifen Küstengneis. Die Grenzziehung zwischen Gneisgranit und Karlshamngranit war nach Ansicht Larssons durch Übergänge zwischen beiden Gesteinen und dem Fehlen scharfer Kontakte erschwert. Der Gneisgranit zeigt s und B, B in gleicher Orientierung wie im Küstengneis. Mit fortschreitender Annäherung an den Karlshamngranit werden s und B weniger und weniger sichtbar, welches auf zunehmende Umkristallisation und besonders kräftige Mikroklinaugenbildung zurückgeführt wird. Für das Festlegen der Grenze zwischen Gneisgranit und Karlshamngranit benutzte Larsson die freisichtige Erkennbarkeit von s und B. Waren diese beobachtbar, wurde Gneis kartiert, wenn nicht: dann Granit.

Gefügekundlich wurden sowohl am Gneisgranit, als auch am Karlshamngranit gleiche Arbeiten wie im Küstengneisgebiet durchgeführt. Sie hatten zum Resultat, dass der Gneisgranit megaskopisch und der Karlshamngranit durch Korngefügeanalysen als BS $\lesseqgtr$ SB-Tektonite definiert werden konnten. Bei beiden Gesteinen waren die B mit jenen des Küstengneises konform. Das Auffinden von gleichartig sich wiederholenden BS — SB — BS — SB — usw. -Zonen im Gneisgranit und Karlshamngranit lassen Larsson zu dem Schluss kommen — wenn in der Abhandlung auch nur bescheiden vermerkt: dass der Küstengneis und Granitgneis gleichzeitig gefaltet seien und dasselbe Ausgangsmaterial darstellten, das nur jetzt mit verschiedenem Metamorphosegrad vorliegt. Der Karlshamngranit hat, mit seinen konform zum omgebenden Gneisgranit relikten BS und SB Zonen, ein deutliches Amplatzgefüge, welches — im Zusammenhang mit den fehlenden Kontakten Anlass zu der Deutung eines regionalmetamorphosen Granitisationsproduktes gibt.

Nun sind dies Resultate, die man kaum in einer von einem Geographen geschriebenen Abhandlung erwartet. Sie zeigen ausser der Bemühung mit der Gefügekunde, dass Larsson auch die aktuellen Probleme der Grundgebirgsgeologie nicht fremd sind. Schwächen bei Handhabung der Methoden sind beim Herübergreifen in ein Nachbarfach natürlich zu erwarten. Die hierauf diesbezüglich folgenden Anmerkungen für den Gefügeteil — und das soll betont vorausgeschickt werden, haben keine grundsätzliche Beeinflussung obiger Arbeitsresultate zur Folge.

Betreffend der Petrographie sei Folgendes noch schnell nachgetragen: »Phenocryst» zur Kennzeichnung der Mikroklinaugen ist ungeeignet.

Damit wird das Gegenteil von dem ausgesagt, was der Verfasser zu beweisen sucht. »Phenokryst» hat nicht nur eine beschreibende Bedeutung, sondern auch genetisch als Erstausscheidung im Magma. Der diskutierte Mikroklin als Sprossung im Starrgefüge ist ein Kristalloblast oder Porphyroblast.

Wie wurde ohne mikroskopische Analyse festgestellt, dass der Mikroklin mit M (010) parallel dem Glimmer-s liegt? Konnten die ausgeprägten Spaltbarkeitsflächen nicht ebenfalls P (100) sein!

### Zu den Flächen- und Achsengefügen

Man liest grundsätzlich an Stelle von Besetzungsdichte — Tautozonalität. Besetzungsdichte (Verteilung von hier Gefügedaten im Schmidt'schen Netz) hat nun wahrhaftig nichts gemeinsam mit dem Begriff der Tautozonalität (= Kristall- oder Gefügeflächen die einer Geraden parallel gehen, oder eine Geradenrichtung gemeinsam haben, sind tautozonal). Einige Beispiele: S. 57 »A comparison between B and $\beta$ shows stronger tautozonality of the planar-Gefüge». Nun können weder B noch $\beta$ als Lineare Tautozonalität zeigen, sondern nur die den $\beta$ zuordenbaren Flächen. — S.58 »A stronger tautozonality of the planar Gefüge than that of the axial seems evident». Hier gilt gleiches wie vorher. Aus dem Zusammenhang geht deutlich hervor, dass Larsson mit Tautozonalität Besetzungsdichte meint, was auch auf S. 53 aus folgendem Satze zu entnehmen ist: »The tautozonality, or the intensity of the maximum can be derived from the amount (in %) of the $\beta$-poles which lie inside a certain isarithm of the diagram.» $\beta$ sind keine Pole!

So ist u. a. auch in Fig. 27 bei der Unterschrift an Stelle von Tautozonalität — Besetzungsdichte zu lesen. Das Diagram stellt die Intensität der Maxima für $\beta$ in % für die einzelnen Homogenitätszonen mittels einer Kurve dar. Damit ist nichts weiter ausgesagt, als die graphische Darstellung der Spitzenwerte der Besetzungsdichten für $\beta$. Was hingegen interessiert hätte, das wäre der Regelungsgrad gewesen; also das Verhältnis von Besetzungsdichten und zuordenbaren Arealen im Diagramm (vgl. Drescher-Kaaden 1954, Koark 1952, 1954).

Die Kurve selbst ist auch nicht ohne Fehler. Die Prüfung der für die Kurve grundlegenden Diagramme ergab ein Missverhältnis zwischen s und den konstruktiv ermittelten $\beta$ (als Schnittpunkte sich schneidender s-Grosskreise im Diagramm) wie folgt:

| | | | | | |
|---|---|---|---|---|---|
| Fig. 28 a | an Stelle von | 491 = 496 β | Es fehlen | 5 = 1.0 % | der β |
| Fig. 28 c | » | 240 = 253 » | » | 13 = 5.1 % | » |
| Fig. 29 a | » | 201 = 210 » | » | 9 = 4.3 % | » |
| Fig. 30 a | » | 231 = 236 » | » | 5 = 2.1 % | » |
| Fig. 30 c | » | 402 = 465 » | » | 63 = 12.9 % | » |
| Fig. 31 a | » | 402 = 435 » | » | 33 = 7.6 % | » |
| Fig. 31 c | » | 778 = 1 225 » | » | 447 = 36.6 % | » |
| Fig. 32 a | » | 604 = 630 » | » | 26 = 4.1 % | » |

Dem Referent ist nicht unbekannt, dass bei hoher Anzahl von s und nur geringer Tautozonalität graphische Schwierigkeiten bei der Konstruktion und Auszählung der $\beta$ auftreten können. Dann sollte man jedoch nicht dieselben als Grundlage für obige Weiterbehandlungen verwenden.

Auch haben sich eine Reihe Inkonsequenzen eingeschlichen, u. a. als Beispiele:

S. 15: »In the BS-type, the B-axis may be defined as 'der Diktator der Regelung' (Sander 1950, p. 92) . . . . .» Eine Bemerkung im obigen Zusammenhang findet sich natürlich nicht bei Sander, denn eine B-Achse kann unmöglich Diktator der Regelung sein, sondern nur deren Resultat!

S. 55: »The set of s-poles group around the $\pi$-circle, . . . .» Die s-Pole gruppieren sich nicht um den $\pi$-Kreis, sondern als $\pi$-Kreis. Einige Zeilen weiter: »As the $\beta$-maximum is more well-defined than the set of B-axes the planar Gefüge is the youngest.» Hier ist nicht das s-Flächengefüge jünger, sondern die jetztige Orientierung der s ist später als die Prägung der s erfolgt!

S. 63: »A well-defined $\pi$-pole and $\perp$ to it a $\pi$-circle is found in the diagram.» Nicht den $\pi$-Pol findet man zuerst, sondern den $\pi$-Kreis: konstruiert aufgrund der tautozonalen Anordnung der s-Pole und als Lot auf diesen der sogenannte $\pi$-Pol.

## Zu den Korngefügeanalysen

Wie bereits erwähnt, wurde die Korngefügeanalyse zur Typisierung der Tektonite angewendet. Korngefügekundliche Probleme sind nicht diskutiert. Die Rekonstruktion des Faltengebäudes geschah mit Hilfe der Glimmermessungen. Quarz wurde nur in einigen Fällen analysiert. Der interessante Regelungstyp wird nur wenig beschrieben und nicht gedeutet.

Welcher Zweck hinsichtlich der tektonischen Analyse mit den Quarzmessungen verfolgt wurde, ist nicht ausreichend deutlich gemacht. Nachdem sie aber einmal angewandt, wäre von grösserem Nutzen gewesen, wenn der Verfasser die angeblich[1] freisichtig nicht beobachtbaren B in den Quarziten der Västanåformation mittels Korngefüge festgelegt hätte, um so die Västanåformation mit dem Küstengneis auch in Hinsicht auf das Achsengefüge korrelieren zu können.

Ein Teil der in die Karte projizierten Korngefügediagramme für Biotit und Quarz ist nur mit den E—W Koordinaten in dieselbe orientiert. Es ist nicht ersichtlich, ob die im Grundkreis um 90° vom E- und W-Pol entfernten Marken den N- und S-Pol darstellen sollen, weil nicht beschriftet. Wahrscheinlich nicht, denn die senkrecht bis sehr steilen B in den Diagrammen der Karte übereinstimmen nicht mit der Lage jener in der Natur. Andere Diagramme sind überhaupt nicht orientiert. — Der Sinn petrotektonischer Karten mit eingesetzten Gefügedaten (-diagrammen) ist die petrotektonischen Feldverhältnisse darzustellen. Die LARSSON'sche Karte führt hingegen irre, indem beim Betrachter der Eindruck erweckt wird, ein mit senkrechten und sehr steilen Achsen gefaltetes oder eingeengtes Gebiet vorsichzuhaben.

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[1] Wie wurden dann die Klüfte als *(ac)* erkannt, wenn sich keine B finden? Alle ca 30 am Mineralog. Inst. der Univ. Uppsala befindlichen Handstücke der Västanåformation zeigen ausserordentlich deutliche B!

Hier hätte sich also eine Rotation der Gefügedaten in die Koordinaten der Karte gehört. — Allgemein ist im Hinblick auf Rotationen von Korngefügedaten im Diagramm zu sagen, (vgl. Fig. 4), dass sie nach Ansicht des Referenten dann nicht ohne Fehlermöglichkeit sind, falls die rotierten Körnerlagen für die neue Situation und ihre diesbezügliche Schnittlage als repräsentativ angesehen werden. Ausgenommen der Fall, wo die Homogenität des Gefüges untersucht ist (SANDER's Achsenverteilungsanalyse).

LARSSON's Hinweis auf die Äusserung INGERSON's, wonach kleingefaltete Gesteine für den Schliffbereich nichtrotierbare Inhomogenitäten aufweisen können, ist nach meinen Erfahrungen auch bei anderen Gefügetypen nicht ausgeschlossen.

Für Untersuchungen über den verschiedenen Erosionswiderstand geregelter Korngefüge steht dem Gefügepetrologen ein noch weites Arbeitsfeld offen (Einwirkung verschiedener Erosionsmittel und ihre definierten Auftreffrichtungen auf geologische Körper untersucht in Hinsicht und Abhängigkeit von mineralog. Zusammensetzung, Regelungsgrad, Korngrösse und Korngestalt, Intergranularfilm und Kornbindung, gitterbedingte richtungsverschiedene Reib- und Schlaghärten, usw.).

## Die Kluftgefüge

Die relativ kleinkörnig glimmerarmen Gesteine von Kullaberg weisen engere Kluftnetze auf, als jene mittelkörnigen Gesteinstypen mit ausgeprägtem Glimmer-s in den Blekinger-Küsten- und Granitgneisen. Abgesehen davon, scheinen die Kluftmessungen der beiden Authoren auch in Hinblick auf die Erfassung der Klüfte und ihrer Auswertung verschiedenen Charakter zu haben. Beschränkte sich BEHRENS Kluftanalyse auf einzelne, herausgegriffene, nur mehrere m² grosse Teilbereiche in willkürlicher Verteilung an dem Küstensaum Kullabergs, wobei für den Bereich *alle* auftretenden Kluftflächen — gleich welcher Grössenordnung — erfasst wurden, so scheinen die LARSSON'schen

Messungen z. T. nur (morphologisch ?) ins Auge fallenden Kluftsystemen gegolten zu haben[1]. Das würde allerdings gegen die statistische Behandlung von Gefügedaten verstossen, da so möglicherweise untergeordnete — für Analyse und Synthese dennoch wichtige — Systeme vernachlässigt bzw. unbeobachtet blieben.

Eine mögliche symmetrologische Bezugnahme der Kluftgefüge auf Kullaberg zum Flächen- und Achsengefüge wurde nicht durchgeführt. Es sei zugegeben, dass für Behrens insofern Schwierigkeiten bestanden, als dass nicht immer deutliche B und s greifbar waren. Das ist schade, weil so möglicherweise durch Symmetrievergleiche verschieden alte Kluftsysteme hätten erfasst werden können (im Unterschied zu Ljungner, der das rel. Alter der Klüfte im Bohusgranit aufgrund verschiedener Mineralfüllung bestimmte), so z. B. Klüfte die im Zusammenhang mit der Achsenprägung und solche mit der späteren Horsthebung gebildet wurden.

Für die genetische Behandlung von Klüften, wie sie Larsson in SW-Blekinge versucht, also betreffend ihres Entstehungscharakters (Zug- und Scherklüfte), ihre Einordnung in einem Formungsplan, usw. zum Zwecke der Rekonstruktion des zeitlichen Ablaufes der zum heute angetroffenen Kluftgefüge führt, sei auf die nachwievor aktuellen Bemerkungen Sander's zur Cloos'schen Granittektonik hingewiesen.

Wenn Larsson, wie der Rezensient vermuten muss — mittels Symmetriebetrachtungen zwei verschiedene alte Kluftsysteme scheidet, so ist bis auf oben vermutete »Auslese» nichts einzuwenden. Die ältere Phase ist zeitlich mit den Prägungsakten für B zu parallelisieren. Die Jüngere ist in Übereinstimmung mit Habetha jotnischen Alters. Aus der Arbeit selbst war nicht ersichtlich, unter welchen Gesichtspunkten die alten von den jungen Klüften während Einmessung oder Ausarbeitung abgetrennt wurden. Das Sammeldiagramm (Fig. 64) gibt die Lage der jüngeren Kluftsysteme an. Im Vergleich hierzu müssten die älteren auf B beziehbaren Fugen (vgl. Fig. 3) mit Schwerpunkten für *Okl*(inkl. *ac*)-Klüften in E—W streichen und jene für *hOl* (inkl. *bc*) in N—S. Diese beiden altersverschiedenen Phasen sind somit heteroplan.

Nun scheint es keinesweg gesichert, dass alle ins jeweilige System passenden Fugen auch wirklich zeitlich demselben zugehören. So kann man nicht, wie es Larsson tut, aufgrund von ⊥ B gefundenen und mit Harnischen belegten Kluftflächen den Schluss verallgemeinern, dass es sich um alte ac-Reissklüfte handelt, die nun unter jüngerer Tektonik als

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[1] S. 86: »Other cleavage directions of the field give a varied picture and may be of ocal character.» (!) S. 90: ». . . ., but now only the predominant cleavage will be discussed.» Die weniger hervortretenden Klüfte wurden später nicht behandelt.

Scherklüfte regeneriert wurden. Sowohl B-Achsenprägung kann Scherfugen in *Okl* hervorbringen, als auch Einzelscherflächen können aus dem (hier jüngeren) System herausfallen!

Wie steht es nun mit der Einordnung in das *abc*-Kreuz. Sind alle als Scher- bzw. Zugklüfte benannten Fugen als solche ihrer Entstehung nach kontrolliert und erkannt, oder sind sie lediglich aufgrund ihrer Lage im angenommenen Formungsplan nach den ihnen zukommenden Funktionen bezeichnet? Sind z. B. die von LARSSON WNW—ESE streichenden und flach gegen NNE einfallenden »overthrusting planes» echte Überschiebungsflächen (mit welchen Kriterien?), oder nur als solche benannt, weil sie in *ab* des gedachten Systems liegen und somit nach der SANDER'schen Definition Formungsebene sein können? Werden die in *ac* des jüngeren Systems stehenden Diabasgänge (hier fällt übrigens B mit *ac* der jüngeren Phase zusammen!) als Zugspaltenfüllungen auf die sogen. »overthrusting planes» bezogen? Eine solche *ac*-Kluft wäre dann bei Karlshamn 200 m breit (vgl. Fig. 34)!!

LARSSON sieht die Raumschaffung für die Diabase als jotnisch an, wie kann dann die dieser Öffnungsphase zugeordnete »overthrusting plane» auch im Diabas selbst auftreten (S. 68)? Das bedeutet, dass entweder die Diabasspaltenbildung zu den B-Bildungsakten gehört, oder aber und das ist das Wahrscheinliche: wir haben es nicht nur mit einer, sondern mit zwei jungen Zerklüftungen zu tun.

In Übersicht gebracht, sieht das so aus:

Gotokarelidische Klüftung
Jotnische Spaltenbildung
Diabasfüllung
Postjotnische Zerklüftung

Über die Orientierungen im jüngsten System kann vom Referenten natürlich nichts ausgesagt werden. Nachdem alle Klüfte in Fig. 64 (allerdings weiss man nicht inwieweit Auslese vorliegt) zum *abc* Kreuz der Kluftphase in symmetrischer Beziehung stehen, könnte man auf eine Regeneration des jotnischen Systems durch die postjotnischen Klüfte schliessen. Zur Trennung beider hätte eine Untersuchung der tektonischen Klüfte (nicht Kontraktions-) im Diabas führen können.

Noch einige kurze Anmerkungen: Die Beschreibung der Diagrammsignaturen ist allgemein sparsam. Z. B. auch in den Karten auf Seite 48 und 49 findet man keinen beschreibenden Hinweis über den Inhalt der in die Karten placierten Diagramme. Im Text steht, dass es sich um Kluftmessungen handelt, aber nichts davon, dass die Kurven im Diagramm gleiche Besetzungsdichten von Polen auf die Kluftflächen repräsentieren.

Auf Seite 103 zusammenfasst Larsson seine Resultate in Zusammenang mit der jüngeren Kluftphase (in Nichterkenntnis der noch Jüngeen) und bezieht sie auf das Achsenkreuz, wie folgt: ». . . , where *ac*, he plane of deformation, reflects the common cleavage system of NNE irection = the direction of the dikes and the common valley direction. s *ac*-cracks are tension cracks this goes well with the assumption that he dikes are due to tension action.

⊥ to the plane of deformation the axis *b* = B is the intersecting line f several *hOl* planes = the overthrusting planes and shear planes. wo shear systems *hkO* appear. Numerous *Okl* shear planes appear.» m nächsten Satz behauptet nun der Verfasser, dass eine Gruppe VNW(NW)—ESE(SE) streichender Klüfte nicht diesem System zugeiört — allerdings ohne Begründung. Warum? Diese Kluftrichtung passt loch symmetrologisch ausgezeichnet in die *hOl*-Zone vorgenannten Deformationssystems.

Schliesslich existieren durch frühere Arbeiten von Asklund, A. G. Högbom, Martin, usw. eingehende klufttektonische Studien in angrenenden Gebieten, deren Vergleich sich gelohnt hätte.

Dem Referenten ging es mit vorstehenden Ausführungen darum, einnal Überblick über den vor allem geologisch und gefügekundlichen nhalt beider Arbeiten zu geben, und zum anderen, die schon von ihm . T. als Fakultätsopponent geäusserten Einwände zum Wohle der Veiterarbeit und zur Festlegung der gegenseitigen Standpunkte darustellen. Wenn dasselbe teilweise kritisch geschah, so sei beiden Authoen versichert, dass damit keine Beeinträchtigung der Hochschätzung hrer Arbeitsleistungen und -resultate, sondern nur eine der Sache ienende Aussprache gemeint war.

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# The Stratigraphy of the Southern Cameroons

By

R. A. Reyment

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## Introduction

The area treated in this paper consists of the southern part of the
ritish Mandated Territory of the Cameroons (now known as the
outhern Cameroons). The vegetation of the area is composed of dense
ropical rain forests. Apart from the banana, rubber and palm-oil
lantations of the Cameroons Development Corporation, little farming
carried on. The population is small in comparison with the nearby
rotectorate of Nigeria and as a consequence thereof roads and native
aths are scarce. The conditions from the point of view of the geologist
e not very different from those found by Per Dusén some 60 years
o and most geological observations must still be confined to such
posures as occur in river sections. A further complication is provided
the wide extent of the basalt sheet that covers most of the sedi-
entary area.

The field work providing the basis of this paper was carried out
ring the dry season of 1953 (February to April). The bedrock of the
ea under consideration is composed essentially of gneisses and gneissic
anites of Pre-Cambrian age. Overlying the rocks of the basement
mplex are sedimentary formations of Upper Cretaceous age, various
consolidated sediments of possibly Tertiary age and the Recent
salts and tuffs.

The district investigated stretches from Tiko in the south, along the
ast to Rio-del-Rey to the north west and northwards along the
ungo River to Tombel, including an adjacent, parallel strip from
undu to Lum in the French Cameroons. Dusén (1894) covered a

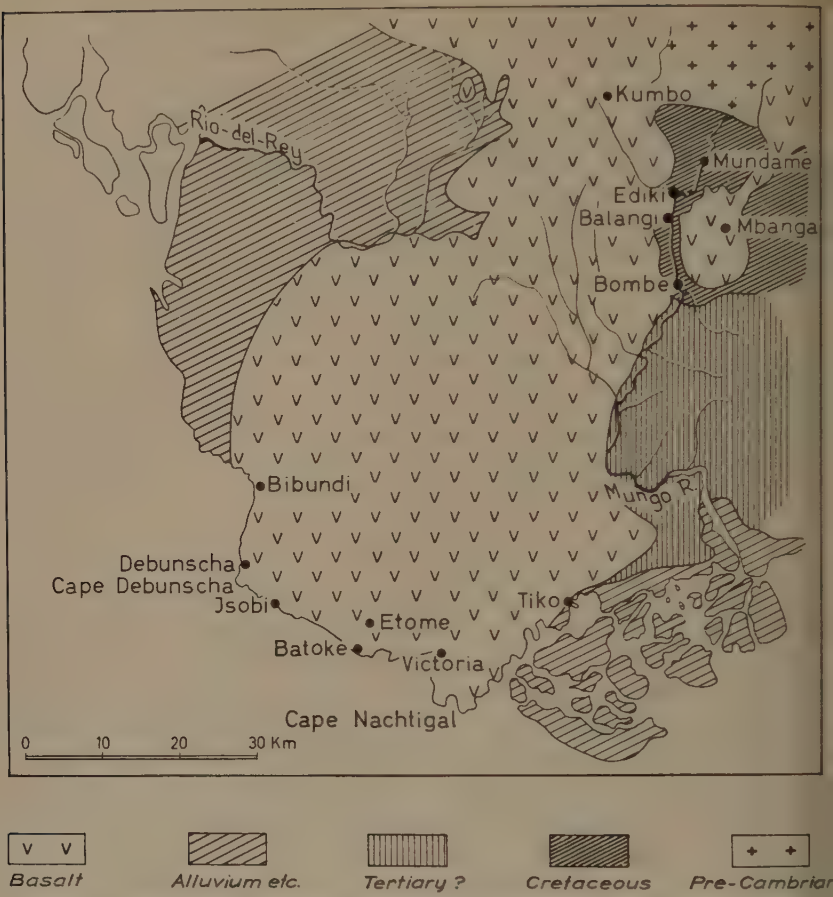

Fig. 1. Sketch map showing the approximative distribution of the various formations mentioned in the text.

belt of country stretching from Duala in the south to Akva Jafe i the nort hand from the Elephant Lake to the mouth of the Calabar Rive

### Previous Work

The history of geologic research begins with a general account o the district between Ndian and Mbonge by the Swedish explorer G Valdau (1892). The first worker definitely to recognize the presence c Cretaceous deposits was Per Dusén, who during the period 1890—189 investigated the same region as is covered in this report. He mentione the presence of beds with Cretaceous fossils near Rio-del-Rey and th existence of sediments in the Mungo River. Von Reichenbach (1896 noted the existence of beds younger than Pre-Cambrian in age, apparently without being aware of Dusén's work.

The key to the stratigraphy of the Cameroons is provided, however, y the Mungo River profile, the only continuous section available. on Koenen described a collection made by Wilsing from the upper eaches of the Mungo River (1897). He realized the presence of a new orm and in his second paper (1898, p. 12) created the ammonite genus *oplitoides.*[1] All the species in the Wilsing collection are actually of ower Turonian age, but Von Koenen assigned the fauna to the Lower retaceous on analogy with the hoplitan faunas of Europe.

Shortly afterwards Esch made a systematic collection from the lungo River which was worked on by Solger (1901, 1904). Solger eached the conclusion that the beds were of Turonian to Emscherian ge. The Esch collection did not take in the whole length of the profile, ut only went as far as Balangi[2].

In 1909, Guillemain carried out a detailed investigation of the ntire Cretaceous part of the river section and the collections made ere given to Harbort for study. A joint preliminary account of the aterial was published in 1909, in which it was stated that Harbort as to monograph the collection. It was not, however, until 1930 (after ne death of Harbort) that L. Riedel began the serious study of the aterial, the results of which were published in 1932. Riedel was unable explain satisfactorily the strangely mixed nature of the collection s a whole (Harbort had gathered together the various collections ade before and after Guillemain's) and was obliged to include a apter in his monograph (1932, p. 11) that offered theories for the lischfauna». The most plausible explanation is that during the 20 ears in which the various collections lay unworked in Harbort's ossession, confusion of the labels took place. This idea has also been it forward by Riedel (1932, p. 11). In 1943 Gèze made a general ntribution to the stratigraphy of the Cameroons in his work on the ology and geography of both the British and French mandated terri- ries. His geologic observations were based principally on the works previous investigators and he followed Riedel in referring the Mungo diments entirely to the Emscherian substage of the Senonian stage.

---

[1] Hoplitoides — like Hoplites. Von Koenen was misled by the external appearance the Cameroons ammonites.

[2] The place names on the Mungo River have been variously spelled by different hors. In the area under consideration there is only one village of any size, Bombe. other localities cited in the literature were originally introduced as terms of con- ience, the names often being taken from the owners of native farms in the vicinities mportant outcrops. For this reason the author has preferred to number the outcrops ead of using such vague terms as »below Balangi» and »above Tiki», etc. The names d here for the Mungo section are: Mundeck, Mundame, Ediki (also referred to as Diki Tiki by previous authors), Balangi (also termed Mbalangi) and Bombe (sometimes rred to as Bakundu-ba-Bombe).

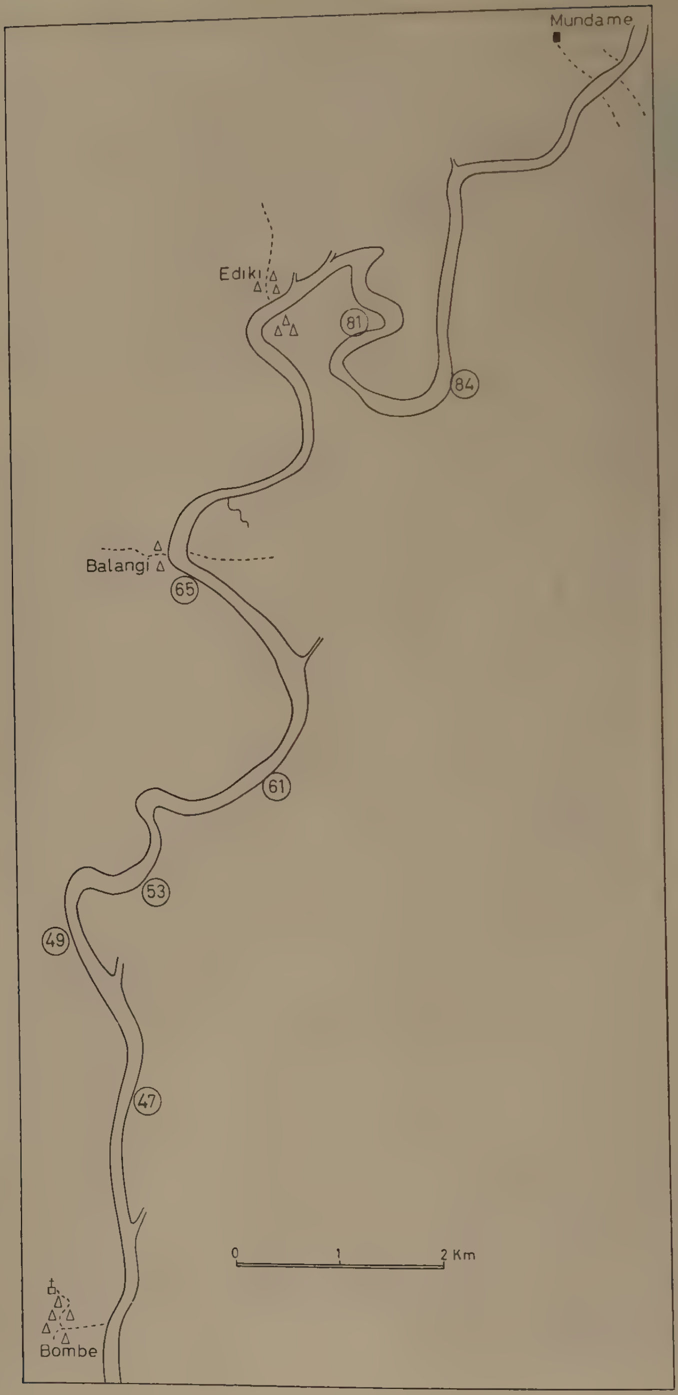

Fig. 2. Loca ty map of t Mungo Rive between Bom and Mundam

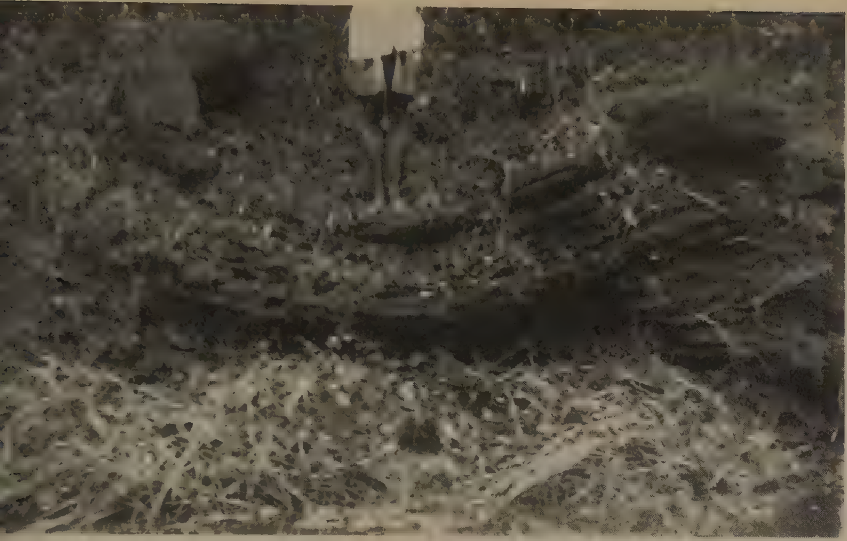

Fig. 3. Synclinal fold in the Coniacian Bombe beds. The sequence here is composed of alternating sandstones and sandy shales.

### The Mungo River Formation

The name *Mungo River Formation* is proposed for the sedimentary sequence exposed between 10 km north of Mundame and approximately km south of Bombe in the Mungo River. The formation consists principally of sandstones with less frequent intercalations of limestones and shales, the former often fossiliferous, and is overlain unconformably by unconsolidated sediments of probably Tertiary age. The deposition of this formation began in Lower Turonian time with a thick series of unfossiliferous sandstones at Mundeck that lie directly on the Pre-Cambrian gneisses and gneissic granites. These sandstones are overlain by the fossiliferous sediments at Mundame consisting of alternating hales, limestones, calcareous shales, limestone conglomerates and calcareous sandstones. Here (localities 84 and 81 in fig. 2) numerous molluscs were collected and it seems highly probable that he Mundame beds correspond to the »Wohltmannbank» and »Elephantenbank» of Wilsing and Von Koenen. The beds dip at a gentle ngle towards the coast. Further downstream at Ediki occurs a seqence f probable Upper Turonian age composed mainly of sandstones, hales and calcareous beds. The next definite horizon in the formation was recognized at Bombe and is of Coniacian age. Its beds are com-osed of gently folded limestones, sandstones and shales (see fig. 3). Evidence for folding was not observed in the sandstones at Mundeck nor at Mundame or Ediki which suggests that the folding is either confined to the center of the formation where the sediments are thicker and not protected by the underlying crystalline basement or else may not have been detected owing to the scarcity of exposures. The Bombe sediments are overlain by the youngest fossiliferous beds of Cretaceous age in the district, the sandstones at Balangi of Coniacian to possibly Campanian age. The Balangi sandstones have yielded a small but diagnostic fauna of Santonian and Coniacian cephalopods and are composed of massive sandstones with less frequent intercalations of calcareous sandstones. This member is of very limited distribution.

Some of the important outcrops in the Mungo River are described below in order to present a general picture of the nature of the Mungo sequence. (All sections are orientated with the youngest beds at the top.)

1. Outcrop 84: Here the beds dip southwards at 4°. The following section was measured:

| | |
|---|---|
| Red earth | approx. 30 m |
| Blue-grey shale | 0,35 » |
| Limestone containing occasional lamellibranchs | 0,35 » |
| Calcareous shale | 0,80 » |
| Limestone containing ammonites and other molluscs. | ? |

The following fossils were identified:

*Neoptychites telingaeformis* Solger
» *perovalis* (von Koenen)
*Hoplitoides ingens* (von Koenen)
» *koeneni* Solger
*Kamerunoceras eschii* (Solger)
*Neoptychites* sp. indet.
*Pholadomya incurvata* Riedel
*Rostellana* aff. *constricta* Dall
*Modiolus* aff. *typicus* Forbes
*Cardium* (*Protocardia*) *pauli* Coquand
*Avicula* cf. *gastrodes* Meek
*Aphrodina wohltmanni* (von Koenen)
*Veniella mortoni* Meek?
*Plicatula flattersi* Coquand.

The above molluscan fauna indicates without a doubt a Lower Turonian age for the beds, comparable in age with the fauna of the

Wadatta limestone (or Intermediate Beds, Reyment, 1954 a), i. e., upper Lower Turonian.

2. Outcrop 81: This outcrop, which occurs about 3/4 km downstream from outcrop 84, also dips at 4° southwards. The following section was recorded:

| | |
|---|---|
| Red earth | unmeasured |
| Blue-grey shale with occasional pebbles of limestone | 0,75 m |
| Limestone containing fragmentary impressions of lamellibranchs | 0,30 » |
| Calcareous clay-shale | 0,45 » |
| Limestone conglomerate containing ammonites and lamellibranchs | ? |

The following molluscs were collected:

*Hoplitoides ingens* (von Koenen)
» *gibbosulus* (von Koenen)
*Plagiostoma pseudohörnesi* Riedel
*Inoceramus camerunensis* (Riedel) ex Heinz
*Cytherea* sp.

This locality also belongs to the Mundame sequence and is of the same age as the fauna recorded from outcrop 84. All the ammonites come from the limestone conglomerate and their state of preservation clearly indicates reworking.

3. Outcrop 64: This locality is situated on the southern limb of a shallow syncline. The beds dip 5° north. The following section was recorded:

| | |
|---|---|
| Red sandy earth | approx. 20 m |
| Brown, weathered shale | 0,95 » |
| Blue-green shale | 0,30 » |
| Well-bedded limestone | 1,20 » |
| Blue clay-shale containing abundant plant remains | 0,40 » |
| Limestone | 0,90 » |
| Blue-grey shale containing nodules of fossiliferous limestone | 1,10 » |
| Limestone | ? |

The following fossils were obtained:

*Barroisiceras* (*Barroisiceras*) sp. indet.
*Pholadomya adversa* Riedel
*Inoceramus* sp.
*Patella* sp.
*Cardium* sp.

This locality, is Coniacian in age as is indicated by the presence of the ammonite genus *Barroisiceras.*

4. Outcrop 61: The following section was measured here:

| | | |
|---|---|---|
| Red earth | approx. 20 | m |
| Arenaceous limestone | 3,50 | » |
| Grey shale | 0,25 | » |
| Limestone containing numerous fragmentary molluscs | 0.60 | » |
| Weathered shale | 3,10 | » |
| Fossiliferous limestone | 0,30 | » |
| Blue-grey shale | 0,20 | » |
| Fossiliferous limestone | 0,35 | » |
| Blue shale | 0,10 | » |
| Fossiliferous shale | 0,30 | » |
| Grey shale | 0,25 | » |
| Fossiliferous limestone | 0,40 | » |
| Arenaceous limestone with occasional fragmentary molluscs | ? | |

The following fossils were identified:

*Tissotia latelobata* Solger
» sp. nov.
» sp. juv.
*Barroisiceras* sp.
*Peroniceras latelobatum* Riedel
*Plicatula* cf. *hirsuta* Coquand
*Nerita* sp.
*Pinna* sp.
*Brachidontes* sp.
*Cardium subperobliquum* Riedel
*Venericardia* sp.
*Pseudocucullaea lens obliqua* Solger
*Plicatula* cf. *renniei* Cox
*Venericardia nauliensis* Cox
*Martesia* sp.
*Astarte* sp.

The ammonites present in this fauna are typical of the Coniacian substage. The locality here described belongs to the Bombe sequence

5. Outcrop 53: A calcareous sandstone exposed in a small shallow syncline represents the youngest horizon with indisputable fossil evidence of its age found to date in the Cretaceous of the Came-

roons. The sandstone gradually becomes less calcareous away from the axis of the syncline. The upper part of this sequence is Santonian-Campanian? in age and the lower part Coniacian. The following molluscs were collected from the calcareous sandstones near Balangi:

*Submortoniceras* aff. *soutoni* (Baily)
*Texanites quattuornodosus* (Lasswitz)
*Plicatula renniei* Cox
*Agelasina plenodonta* Riedel

*Age of the Mungo River Formation.* The various conceptions previously held concerning the age of the Mungo beds have already been briefly touched upon. The Lower Cretaceous age assigned by von Koenen need not be considered further since it was based on a false analogy. The next determination requiring consideration is that of Solger (1904) and it is here discussed in some detail. The material studied by that author came from the 1897/98 expedition of Esch. On p. 86 Solger made this general remark concerning the age of the sequence, »Alle diese Gesteine gehören der oberen Kreideformation an und zwar dem Senon und Turon». Solger considered all the limestone outcrops to belong to the same horizon and the present investigation has in part confirmed this (remembering that the Esch collection took in only the upper reaches of the river), since repetition of various horizons occurs owing to gentle folding. Solger assumed that the deposits had been lain down in a shallow sea. His condensed opinion concerning the age of the beds is, »Unterturon ist in den Mungokalken jedenfalls vertreten, ebenso Untersenon, d. h. Emscher. Wahrscheinlich kommen auch oberturone Schichten vor, vielleicht auch cenomane. Dagegen liegen keine Gründe vor, noch ältere Schichten anzunehmen, und bis zur Auffindung von Fossilien, die einwandfrei das Vorhandensein von unterer Kreide dartun, muss der Mungokalk für Turon (bezw. Cenoman) bis Untersenon gelten» (1904, p. 200).

It is nevertheless significant that Solger was led to mention that he was unable to say whether the Lower Turonian and Senonian were mixed. He thought that faulting, incorrect compass readings or careless abelling of the specimens may have given rise to the confusion in the collection. Esch admitted the possibility of the latter explanation but not the two former. Solger observed that the mode of collection employed by the Esch expedition was apparently to work over loose blocks that had fallen from the limestone outcrops into the bed of the iver. The present author's own study material was made from outcrops high in the banks of the river owing to the high water-level encountered so that the question of mixed collecting does not arise. Perusal of GUILLEMAIN's record discloses the fact that he also collected *in situ* for the same reason and in neither his collection nor mine does any suggestion of »Mischfaunen» appear. Nevertheless, despite the handicap of being obliged to work an obviously inaccurate collection, SOLGER's result most closely approximates to the view held in the present paper. The Mundeck sandstones were regarded by SOLGER as being possibly Cenomanian. In the light of recent research in both Nigeria and the Cameroons it seems most likely that these beds can be most safely equated with the lower Lower Turonian (see REYMENT, 1954 a).

RIEDEL (1932) published a comprehensive monograph of the molluscs of the Mungo River. This work was based on four existing collections besides the GUILLEMAIN collection that had been entrusted to HARBORT for description. RIEDEL placed the thickness of the Mungo River Formation at about 14—1600 meters and noted (1932, p. 5) that overlying the Upper Cretaceous, Tertiary beds occur to the south. The transitional beds are not known. His opinion of the age of the sequence is given in the following words (1932, p. 6), »— werde ich nachzuweisen versuchen, dass zwar die ältesten auftretenden Schichten dem Emscher angehören, dass es aber nicht festgestellt werden kann, bis in welchen Horisont die jüngsten Schichten hinaufgehen». Further on, (1932, p. 19) he places the whole succession in the range Lower Emscherian to Maestrichtian without admitting any possibility for the presence of Turonian. RIEDEL also concluded that the Mungo fauna was mixed and offered the following explanations. Firstly that there is a fault between Ediki and Balangi. This idea had also been put forward by GUILLEMAIN (1909, p. 48) but it was dismissed as being unlikely. Secondly (1932, p. 21), he noted that, »Aus der Besprechung der Faunen der einzelnen Fundorte geht hervor, dass an der meisten Fundpunkten Formen zusammen vorkommen, die anderorts in verschiedenen stratigraphischen Niveaus auftreten.» In connection herewith he suggested the presence of flat folds and saddles, but remarked that neither ESCH nor GUILLEMAIN had reported the existence of any such thing. RIEDEL's age determination was further confused by his considerable reliance on the *Inoceramus* determinations made by HEINZ, which in most cases conflicted with the evidence supplied by the ammonoidea.

Another worker to be concerned with the age of the Mungo River Formation was GÈZE who in 1943 published a large work on the geography and geology of the French and British Cameroons. He considered the Cretaceous of the Mungo River to dip SSW at from 5° to 10° and to disappear around Ndo[1] beneath the Tertiary deposits. He mentioned that various estimates of the thickness have been made — from 150 m up to 1,500 m. I agree with GÈZE who pointed out that the former figure is most probably correct. The list of fossils from the Mungo River cited by GÈZE is inaccurate and contains at least one invalid name. As regards the question of mixed faunas he noted (1943, p. 98) that the work of a French petroleum company had disclosed the presence of numerous small faults which could cause repetition of stratigraphic levels. Apart from occasional local faulting on a small scale nothing of sufficient magnitude to result in stratigraphic irregularites was observed by the present writer. GÈZE agreed with RIEDEL's determination and referred the entire Mungo fauna to the Senonian (Coniacian to Maestrichtian). More recently ROCH (1953, p. 50) has admitted the possibility of the Mungo Cretaceous beginning in the Turonian, but is convinced that it extends up to the Maestrichtian-Danian. This is a combination of the conceptions put forward by SOLGER and RIEDEL.

### Palaeontological Review of the Molluscan Faunas of the Mungo River Formation

Tables 1, 2 and 3 present revised lists of the Cameroons Cretaceous molluscs together with new finds and corrected localities[2].

A few points requiring discussion arise from Table 1. The figures given by SOLGER for »*Acanthoceras*» *eschii* are obviously restored from very unsatisfactory material and by no means present an accurate picture of the true nature of this ammonite. As pointed out elsewhere this form is clearly related to *Benueites* Reyment. The Mungo River *Barroisiceras* fauna is of particlar importance since it provided much of the basis for the revision of the Barroisiceratinae by REESIDE (1932) and BASSE (1947). I have recently made a number of emendations to this important Coniacian subfamily based mainly on forms from northern Nigeria (REYMENT, 1954 c).

*Neoptychites* Kossmat is a Lower Turonian genus found in India, Tunisia, France, Nigeria and the Middle East. *Hoplitoides* von Koenen ranges from the Lower Turonian to the basal Coniacian and has been recorded from Nigeria, Colombia, Tunisia, the Middle East, etc. The Coniacian species listed belong to widely distributed genera. *Solgerites*

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[1] The present investigation showed that the Cretaceous sediments continue more than alf a mile downstream from Ndo (as designated on RIEDEL's map of the Mungo River). There is, however, much discrepancy in the literature concerning the exact site of this village». My own enquiries support RIEDEL's information.

[2] All fossils collected by the writer are preserved in the British Museum (Natural History), London and in the following tables are marked with an asterisk. The numbers iven in column three of the tables are those set out on fig. 2.

**Table 1**

CEPHALOPODA

| Fossil | Age | Occurrence | Localities given by previous authors | |
|---|---|---|---|---|
| | | | Solger | Riedel |
| *Parapachydiscus* cf. *stallauense* Imkeller | Coniacian | 47 | | Bombe<br>unknown |
| *Neoptychites* | | | | |
| — *telingaeformis* Solger* | L. Turon | 84 | | Profil I |
| — *perovalis* (von Koenen)* | » | 84 | Balangi | |
| — *crassus* Solger | » | 84 | unknown | Profil I |
| *Hoplitoides* | | | | |
| — *ingens* (von Koenen)* | » | 84, 81 | Elephantenbank | Profil I |
| — *gibbosulus* (von Koenen)* | » | 84, 81 | | |
| — *wohltmanni* (von Koenen)* | » | 84 | Elephantenbank | |
| — *koeneni* Solger* | » | 84 | uncertain | Profil I |
| *Kamerunoceras eschii* (Solger)* | » | 84 | Ediki? | |
| *Pachydesmoceras kamerunense* (von Koenen) | » | 84? | Wohltmannbank | Profil VI |
| *Tissotia* | | | | |
| — *latelobata* Solger* | Coniacian | 61, 49 | | Balangi |
| — cf. *redtenbacheri* de Grossouvre | » | 61 | | |
| — *polygona* Solger | » | ? | | Profil VI |
| — aff. *djelfensis* Péron | » | 49 | | Profil V |
| *Choffaticeras* | | | | |
| — (*Choffaticeras*) *koeneni* (Riedel) | Turonian | ? | Balangi | |
| — (*Leoniceras*) *philippii* (Solger) | » | ? | | Balangi<br>unknown |
| *Peroniceras* | | | | |
| — *latelobatum* Riedel* | Coniacian | 61 | | Profil V |
| — *czörnigi* (Redtenbacher) | » | ? | | |
| — aff. *cocchi* Meneghini | » | ? | Ediki? | |
| — *dravidicum* (Kossmat) | » | ? | uncertain | |
| *Solgerites* | | | | |
| — *armatus* (Solger) | » | ? | uncertain | |
| — *mitis* (Solger) | » | ? | uncertain | |
| *Forresteria* | | | | |
| — (*Harleites*) *harlei* (de Gross) | » | ? | uncertain | |
| — (*Reesideoceras*) *camerounense* (Basse) | » | ? | | |
| *Submortoniceras* aff. *soutoni* (Baily)* | Santonian | 53 | | |
| *Texanites quattuornodosus* (Lasswitz)* | » | 53 | | |
| *Romaniceras* | | | | |
| — aff *uchauxiense* Collignon* | U. Turon? | 67? | | |
| — aff. *deverioide* (de Gross.)* | » | 67? | | |

*brancoi* has been recorded from Colombia and Peru; *Tissotia* is a well-known Coniacian genus, as is also *Peroniceras;* and *Forresteria* occurs in the Coniacian of the United States and Nigeria.

The stratigraphic position of the youngest ammonite assemblage o the Mungo River Formation (i. e. from the Balangi sandstones) poses a interesting problem. According to Collignon (1948) and Spath (1921 1953) the types of peroniceratids represented in Madagascar and South

## Table 2[1]

### GASTROPODA

| Fossil | Age | Occurrence | Riedel's localities |
|---|---|---|---|
| *Basilissa antigua* Riedel | Coniacian | 47 | Bombe |
| *Nerita multigranosa* von Koenen | L. Turon. | 84 | below Mundame |
| *Neritodomus rectus* Riedel | ? | ? | unknown |
| *Solarium (Semisolarium) leve* Riedel | ? | ? | unknown |
| » *(Climacopoma) leveumbilicatum* Riedel* | Coniacian | 47 | unknown |
| *Gyrodes tenellus* Stoliczka | » | 47 | Bombe |
| » cf. *edura* Stoliczka | » | 47 | Bombe |
| *Ampullospira bulbiformis* (Sowerby)? | » | 47 | Bombe |
| *Lunatia leptostomata* Riedel | » | 47 | Bombe |
| » *climacodes* Riedel | ? | ? | unknown |
| *Scalaria? varicostata* Riedel* | Coniacian | 47, 49 | unknown |
| *Turritella nodosa* Römer* | L. Turon.-<br>Coniacian | 84, 47 | Bombe |
| » *harborti* Riedel* | Coniacian-<br>L. Turon. | 84, 47 | below Balangi<br>Profil I, |
| » cf. *tippana* Conrad | ? | ? | unknown |
| *Faunus beyenburgi* Riedel | Coniacian | 47 | Bombe |
| *Cerithiopsis meeki* Wade? | ? | ? | unknown |
| *Pyrazus elongatum* Douvillé* | Coniacian | 47 | Bombe |
| *Cerithium* cf. *annulatum* Zek. | » | 47 | Bombe |
| *Nudivagus simplicus* Wade? | » | 47 | Bombe |
| *Ctenopus neubaueri* Riedel | » | 47 | Bombe |
| *Helicaulax latealata* Riedel* | » | 47 | Bombe |
| *Pugnellus fraasi* (Harbort MS) Riedel* | » | 47 | Bombe |
| » *dietrichi* Riedel | » | 47 | Bombe |
| » *inartus* Riedel | » | 47 | Bombe |
| *Purpura ligata* Riedel* | » | 47 | unknown |
| *Fusus climacodes* Riedel* | » | 47 | Bombe |
| » *cylindricus* Riedel* | » | 50 | unknown |
| *Trochifusus perornatus* Wade? | » | 47? | Bombe |
| *Chrysodomus (Kelletia) constricta* Riedel | ? | ? | unknown |
| *Strepsidura gracilis* Riedel* | Coniacian | 47 | Bombe |
| *Peristernia conica* Riedel | » | 47? | Bombe |
| » *? acutoplicata* Riedel | ? | ? | unknown |
| *Volutilithes guillemaini* Riedel | Coniacian | 47? | Bombe |
| » cf. *pseudocostata* Noetling* | » | 47 | Profil V |
| *Voluta (Palaeosephaea) sulcata* Riedel | » | 47 | Bombe |
| *Rostellana* aff. *constricta* Dall* | L. Turon. | 84 | Profil I |
| *Vespertilio? africana* Riedel | Coniacian | 47 | Bombe |
| *Volutomorpha* sp. nov.* | » | 47 | unknown |
| » *horrida** Riedel | » | 47 | Bombe |
| » *similis* Riedel | » | 47 | Bombe |
| *Drilluta biplicata* Riedel* | » | 49 | Bombe |
| *Cancellaria spellenbergi* Riedel | » | 47 | Bombe |
| *Pleurotoma* aff. *faxensis* Ravn* | » | 47 | unknown |
| *Turris* aff. *kaffraria* Griesbach* | » | 47 | unknown |
| *Ringicula acuta* Forbes? | » | 47 | Bombe |

---

[1] The ages of the fossils given in the second column refer to the relative ages of the beds in which these forms were found as shown by the cephalopod faunas. The age determinations are not meant to be interpreted as necessarily being the time range of any given species. This note also applies to Table 3.

Africa by *Submortoniceras soutoni* and *Texanites quattuornodosus* are indicative of the Campanian. Since the Balangi sandstones, which include also beds of Coniacian age, appear to be conformable, the *Texanites-Submortoniceras* beds have been referred to the Santonian substage.

The two species of *Romaniceras* were obtained from a level above that of the Mundeck sandstones and the Mundame sequence. This genus is as yet incompletely known and it may have made its first appearance in late Cenomanian time, although its principal distribution occurs in the Upper Turonian. Since the Cameroons examples were collected from beds conformably situated between the Lower Turonian and the Coniacian, they are best regarded, for the present at least, as being Upper Turonian in age. Recently, however, I identified *Romaniceras* in a collection of Lower Turonian ammonites from Igumale Division, Benue Province, Nigeria.

The rich gastropod collections described by RIEDEL (1932) were only partially duplicated in the present material. As the fourth column in Table 2 indicates, some of the localities were unknown to RIEDEL. The present work has made it possible to establish the exact locations of a number of the described species. A new species, here referred to as *Volutomorpha* sp. nov., also known from the Coniacian of south—eastern Nigeria, has been described and figured in a paper dealing with Nigerian Upper Cretaceous lamellibranchs and gastropods, at present in the press.

The following points arise from Table 3. Cox (1952, p. 25) made the suggestion that the type of *Pholadomya incurvata* Riedel may be a juvenile example of the specimen recorded by RIEDEL as *Liopistha superba?* Stoliczka. The present writer is inclined to agree with this observation and for the time being, until more material comes to hand, *L. superba?* Stoliczka, Riedel is best regarded as representing the adult stage of *P. incurvata*.

RIEDEL was inclined to attach considerable importance to the stratigraphic information supplied by HEINZ (1932) for the species of *Inoceramus*, with the result that the working out of the stratigraphic succession became confused. *Plicatula renniei* Cox, a Gold Coast Campanian species, ranges from Coniacian to Santonian in the Mungo River. *Agelasina plenodonta* Riedel, whose true affinities are as yet unresolved, and *Cardium subperobliquum* Riedel are known from the Maestrichtian of south-eastern Nigeria (REYMENT, 1954 b, p. 21), as are also *Trigonarca angolensis* Rennie and *Veniella undata* (Conrad).

## Table 3

### LAMELLIBRANCHIATA

| Fossil | Age | Occurrence | Riedel's locality |
|---|---|---|---|
| *Avicula* cf. *gastrodes* Meek* ............ | L. Turon. | 84 | unknown |
| *Inoceramus niger* (Riedel) ex Heinz*[1] ... | Coniacian | 47 | Balangi |
| » *camerunensis* (Riedel) ex Heinz* ................ | L. Turon.-<br>-Coniacian | 84 | Balangi |
| » *bantu* (Riedel) ex Heinz* ... | Coniacian | 47 | Bombe |
| *Pinna latecostata* Stoliczka ............ | L. Turon? | ? | below Mundame, Balangi |
| *Lima perplana* von Koenen* .......... | L. Turon. | 84 | Profil I |
| » (*Plagiostoma*) *pseudohörnesi* Riedel* | L. Turon-<br>Coniacian | 84, 47 | Bombe |
| *Plicatula hirsuta* Coquand ............ | Turon.-<br>Coniacian? | ? | below Mundame,<br>Profil V |
| » cf. *hirsuta* Coquand* ......... | Coniacian | 61 | |
| » cf. *locardi* Thomas & Péron ... | Coniacian? | ? | below Tiki,<br>below Balangi |
| » *instabilis* Stoliczka ........... | Turonian | 67? | above Tiki |
| » *rennici* Cox* ................ | Coniacian-<br>Santonian | 53, 47 | Bombe |
| *Mytilus angulatus* Riedel .............. | Coniacian? | | Balangi |
| *Modiolus* (*Inoperna*) *flagellifera* Forbes* . | Coniacian | 49, 47 | Bombe |
| » aff. *typicus* Forbes ........... | L. Turon. | 84? | Profil I |
| *Pseudocucullaea lens lens* Solger* ....... | Coniacian | 50, 47 | Profil VI |
| » » *obliqua* Solger* .... | » | 50 | Profil VI, Bombe |
| *Trigonarca camerunensis camerunensis* Riedel* ......................... | » | 49, 47 | Profil VI, Bombe |
| *Trigonarca camerunensis curvatodonta* Rdl. | » | 47 | Bombe |
| » *angolensis* Rennie .......... | » | ? | below Tiki,<br>below Balangi |
| *Venericardia nauliensis* Cox* .......... | » | 47 | Profil IV<br>below Balangi,<br>Profil IV,<br>Bombe |
| *Venericardia* sp. nov.[2]* ............... | » | 49 | — |
| *Astarte trigonella* von Koenen .......... | L. Turon. | 84? | Profil I |
| *Granocardium kruschi* Riedel* ......... | Coniacian | 50 | Bombe |
| *Cardium perobliquum* von Koenen ...... | L. Turon. | 84 | below Mundame |
| » aff. *perobliquum* von Koenen*.. | Coniacian | 47 | — |
| » *subperobliquum* Riedel* ....... | » | 50, 47 | Bombe |
| » (*Protocardia*) *pauli* Coquand* .. | L. Turon. | 84 | Profil I |
| *Veniella mortoni* Meek?* ............. | L. Turon. | 84 | Profil I |
| » *undata* (Conrad) .............. | ? | ? | below Mundame,<br>below Tiki |
| *Agelasina plenodonta* Riedel* .......... | Coniacian-<br>Santonian | 53, 49 | below Balangi,<br>Bombe |
| *Cyprimeria* (*Cyclorisma*) *faba* Sowerby?* | L. Turon. | 81 | unknown |

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[1] Some of the *Inoceramus* listed by Riedel and attributed to Heinz are either invalid else synonomous with known species. This point is being discussed more completely another paper.

[2] This species also occurs in the Maestrichtian of south-eastern Nigeria and has been eated in a work at present awaiting publication.

| Fossil | Age | Occur-rence | Riedel's locality |
|---|---|---|---|
| *Aphrodina quenseli* sp. nov.[1] | L. Turon-<br>Coniacian | ? | Balangi, Profil, V.<br>Bombe |
| » *angustosinuosa* Riedel* | L. Turon. | 84 | unknown |
| » *wohltmanni* (von Koenen) | » | ? | unknown |
| » cf. *thomsoni* (Woods) | Coniacian | 47 | Bombe |
| *Pholadomya incurvata* Riedel* | L. Turon. | 84 | Profil I |
| » *adversa* Riedel* | Coniacian | 65 | Bombe |
| » *hians* Riedel | » | 47 | Bombe |
| *Liopistha ventricosa* von Koenen* | L. Turon. | 84 | Profil I |
| *Marteria cylindrica* Riedel | Coniacian | 47 | Bombe |
| *Ostrea* spp.* | L. Turon. | 84 | — |
| *Pecten kamerunensis* von Koenen* | » | 84 | — |
| *Corbula incurvata* von Koenen* | » | 84 | — |
| *Plicatula flattersi* Coquand* | L. Turon.-Coniacian | 84, 47 | — |

### Comparison with the Upper Cretaceous faunas of Nigeria

Comparing the Turonian faunas, it is found that the lowermos Turonian, which is represented in Nigeria by the zone containin abundant vascoceratids (Reyment, 1954 a). is missing in the Cameroons The *Neoptychites-Kamerunoceras-Hoplitoides* assemblage of the lowe Mungo River Formation (Mundame sequence) approximates to th *Benueites-Hoplitoides-Mammites-Kamerunoceras* fauna of the Wadatt limestone near Makurdi, Nigeria and the *Hoplitoides-Neoptychites Mammites* fauna of the Igumale limestones and shales. Thus. Turonia sedimentation in the Cameroons did not begin until after that in Nigeria that is, unless the unfossiliferous Mundeck sandstones at the base o the Mungo River Formation are not the equivalents of the vascoceratic beds in Nigeria.

The Senonian is represented in the Cameroons by the Coniacia Bombe series and the Coniacian-Campanian? Balangi sandstone The Santonian substage has not yet been recognized in Nigeria, bu the Coniacian deposits are readily comparable. The two main Nigeria Coniacian localities occur in the Awgu-Ndeaboh Shales of south-eastern Nigeria and the Upper Limestones of north-eastern Nigeria n general, the Nigerian deposits are less complete than those of the pper part of the Mungo River Formation. Table 4 illustrates the istribution of Cameroons molluscs in the Upper Cretaceous of Nigeria.

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[1] In a paper due to be published shortly the author has pointed out that the assignation of certain Cameroons lamellibranch valves to the well-known species *Callistina plan* (Sowerby) by L. Riedel is incorrect (1932, p. 60, pl. 2, figs. 1 (not 1 a), 3, 3 a; pl. 11, fig 5, 5 a; pl. 12, figs. 2, 2 a; pl. 32, figs. 21—24) and it is therefore here proposed to refe these forms to a new species, *Aphrodina quenseli* (holotype; the example figured in Ried (1932) pl. 12, figs. 2, 2 a). *A. quenseli* differs from a closely related, new Nigerian speci from Awgu, south—eastern Nigeria (to be figured in the above-mentioned forthcomin paper) in having much shorter cardinal teeth, a weaker nymph as well as a more trigon outline. For further comparisons the reader is referred to Riedel (1932, p. 61). This speci is named in honour of Professor Emeritus Percy D. Quensel, Stockholms Högskol Stockholm.

Table 4

DISTRIBUTION OF CAMEROONS MOLLUSCS IN THE UPPER CRETACEOUS OF NIGERIA

| Species | Wadatta | Igumale | Awgu-Ndeaboh Shales | Upper Limestones | Nkporo Shales |
|---|---|---|---|---|---|
| *Cephalopoda* | | | | | |
| *eoptychites telingaeformis* Solger | — | × | — | — | — |
| *oplitoides gibbosulus* (von Koenen) | × | × | — | — | — |
| » *wohltmanni* (von Koenen) | × | — | — | — | — |
| » *ingens* (von Koenen) | × | × | — | — | — |
| » *koeneni* Solger | × | — | — | — | — |
| *issotia latelobata* Solger | — | — | × | — | — |
| » *polygona* Solger | — | — | × | — | — |
| *olgerites mitis* (Solger) | — | — | — | ? | — |
| *orresteria* (*Harleites*) *harlei* (de Grossouvre) | — | — | — | × | — |
| *Gastropoda* | | | | | |
| *urritella nodosa* Römer | — | — | × | — | × |
| *yrazus elongatum* Douvillé | — | — | — | — | × |
| *elicaulax latealata* Riedel | — | — | — | — | × |
| *ostellana* aff. *constricta* Dall | × | — | — | — | — |
| *Lamellibranchiata* | | | | | |
| *noceramus niger* (Riedel) ex Heinz | ? | — | × | — | — |
| » *bantu* (Riedel) ex Heinz | × | — | × | — | × |
| *ima* (*Plagiostoma*) *pseudohörnesi* Riedel | × | — | × | — | — |
| *odiolus* aff. *typicus* Forbes | × | — | — | — | — |
| *seudocucullaea lens obliqua* Solger | — | — | × | — | × |
| *rigonarca angolensis* Rennie | — | — | — | — | × |
| *ranocardium kruschi* Riedel | — | — | — | — | × |
| *ardium subperobliquum* Riedel | — | — | × | — | × |
| *eniella undata* (Conrad) | — | — | × | — | × |
| *gelasina plenodonta* Riedel | — | — | — | — | × |
| *holadomya incurvata* Riedel | — | ? | — | — | — |
| *licatula flattersi* Coquand | × | — | × | — | ? |

## Other Deposits of Cretaceous Age

Dusén did not visit the Mungo area, but was nevertheless aware f the presence of sedimentary deposits there; he confined his observaons to the north-western section of the former German colony, here he discovered sedimentary rocks east of Rio-del-Rey. The most portant occurrence recorded is that of Jongalove, where a section ests directly on the Pre-Cambrian complex. The sequence is as follows:

alcareous sandstones containing fish teeth and poorly preserved molluscs.

lay-shales and micaceous clay-shales containing occasional beds of sandstone as well as concretions.

assive, unfossiliferous sandstones

re-Cambrian.

Similar sequences occur in the Ndian, River and at Lokkelle, Isambenge and Massake. According to DUSÉN, the fish teeth were determined by DAMES who assigned a Cretaceous age to them. The mollusc are too poorly preserved to permit identification. As was pointed ou by DUSÉN, these beds are weakly folded, as are also the beds of th Mungo River sequence. For example, in the Jongalove River, there i a section 1 km. long that shows gentle anticlinal and synclinal folds

Although definite palaeontologic evidence is lacking, there can b little doubt that the Rio-del-Rey deposits (here distinguished as th *Rio-del-Rey Formation*) are the same age as the Mungo River Formation at least in part. Unfortunately, the thick basalt covering in this are prevents extensive observations. Recently ROCH (1953, p. 49) ha suggested that the Rio-del-Rey Formation may be of Albian age. M field observations in the Calabar area, where the sedimentary sequenc begins with the Cenomanian, and the district in question do not suppor this point of view.

GÈZE has collected a good deal of discussion on the possibility o the existence of rocks older than Turonian. GREKOFF (1953, pp. 370 374) put the marls and shales of the Mayo-Tafal area in the north o the French Cameroons into the Wealden on rather shaky evidence this determination has not yet been satisfactorily confirmed. In a late paper on the same area ROCH (1953, p. 43) has suggested that th oldest sediments may be of Paleozoic-age (Formation de Mangbei and he has also placed the younger sediments in various subdivision of the Cretaceous (including the Wealden). The grounds for this strati graphic succession are not convincing. Some of the early Germa authors considered the beds around Adamawa in the north—easter part of the Cameroons to be Jurassic in age without any palaeontologi grounds,and later DIETRICH (1938) even entertained the possibility o Trias occurring in northern Adamawa.

The Mamfe beds (now termed the *Mamfe Formation*[1]) lie to the nort of the Mungo River. They consist of a thick, folded and faulted, serie of massive arkosic sandstones and grits, with intercalations of calcareous beds, shales and carbonaceous beds, and are typically expose in the Cross River at Mamfe (Ossidinge). Apart from occasional find of fossil wood the only fossil known from this formation is the fis *Proportheus kameruni* Jaekel. JAEKEL (1909) stated that this form indicated the presence of beds of Wealden age, but in the light o our present knowledge, this is highly improbable. Albian sediment occur to the north—west of Mamfe and it seems possible that the Mamf ormation is either the lateral equivalent of the Albian shales or else elongs to the Turonian transgression represented further north by ne ammonitiferous Okpauku calcareous shales. The lateral continuaons of the Mungo River Formation into the French Cameroons contain o limestone beds, but consist chiefly of unfossiliferous sandstones ith less frequent intercalations of argillaceous beds. Good exposures ere seen between Mundame and Mbanga and in cuttings in the main kongsamba-Duala highway between Lum and Mbanga.

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[1] I am using this term as the English equivalent of JAEKEL's (1909) »Mamfe Schiefer».

Gèze (1943, p. 92) noted that further fossiliferous beds of Cretaceous ge had been found »sur la voie ferrée de Douala à Yaoundé prés de oungabe à peu distance de ce point, au Sud, vers le lac Ossa et à abe, sur le Nyong». He added that no data had been published conerning this material. On p. 98 in another reference to this locality he ated, »Les calcaires à Ammonites ont été retrouvés vers le Sud, queles kilomètres au Nord du lac Ossa, au contact (par faille) du socle anitogneissique; plus loin encore, au bord du Nyong, les marnes bleuses de Mabe auraient livré *Roudairia Drui*[1], Lamellibranche nnu aussi des calcaires du Moungo, mais nous manquons de précions sur ces données qui n'ont pas été publiées». Until an account of is ammonite fauna becomes available it is decidedly unsafe to risk orrelation of the »grès d'Ossa» with the Mungo River Formation. *Veella undata* (Conrad) (see Table 4) occurs throughout the entire Seonian of Nigeria and can by no means be regarded as a safe zone fossil.

## Younger Formations

The younger sediments of the Southern Cameroons are probably Tertiary, Pleistocene and Recent age. Reference has already been ade to the beds that overlie, apparently unconformably, the Creteous deposits of the Mungo River Formation. These beds (here named e *Mpundu Formation*) are probably Tertiary in age and consist of orly consolidated grits and sandstones that only occasionally display dding. The Mpundu Formation was erroneously correlated with the nde Ameki Series of Nigeria (Middle Eocene to Lower Miocene?) by ze (1943). It stretches from about three quarters of a kilometer uth of Bombe in the Mungo River to Mpundu wharf where it dispears beneath a thick layer of alluvial soil. Exposures of this forman are uncommon owing to the basalt covering and alluvium.

Although no diagnostic fossils have yet been found in these sedints a poorly consolidated, calcareous sandstone near Malende has elded badly preserved molluscan remains. The probable equivalent

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[1] The correct name of this species is *Veniella undata* (Conrad). The name *Roudairia ui* Munier-Chalmas is thus a synonym.

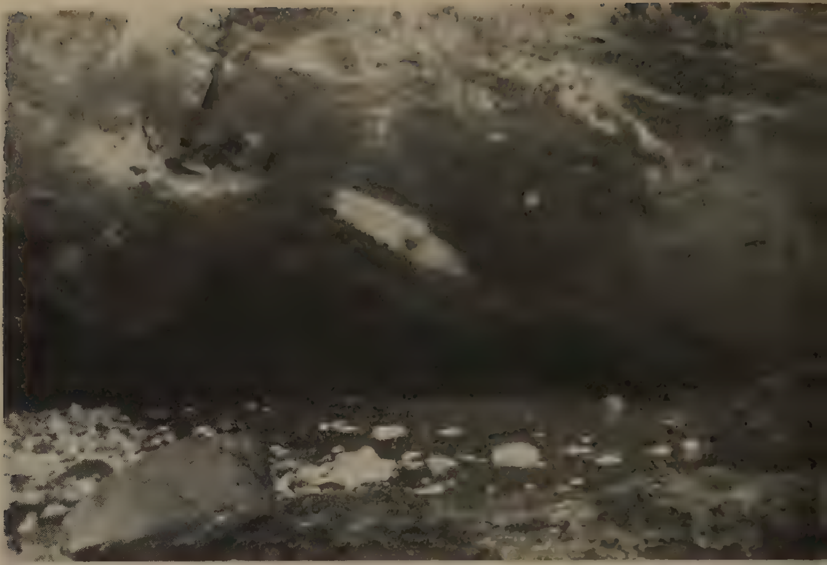

Fig. 4. Discordantly bedded tuff exposed in a cliff section at Cape Debunscha showi a relatively high dip. The tuff contains numerous small basalt »bombs». In the foregrou pieces of rock are visible that have fallen down during a more or less recent landsli Height of the section figured c. 1.5 m. This photograph was taken at a position corr sponding to point »d» on the map given by Dusén (1894, p. 48, fig. 2).

of the Mpundu Formation exposed around Bonagngando on the Wu River in the French Cameroons has yielded numerous fossils whi were described by OPPENHEIM in 1904. The formation is common capped by lava flows, tuff and tuff agglomerate. The present auth was unable to discover any evidence for GUILLEMAIN's assertion th volcanic activity in the Cameroons began during the Cretaceous.[1]

It is outside the scope of this paper to take in the recent erupti rocks of the Southern Cameroons. These have been exhaustively treat on several occasions by a large number of authors [see GÈZE, (1943) f a comprehensive account of Mt. Cameroon[2] and a discussion of previo research on the subject] making any further contributions entire superfluous. Numerous plant remains were collected from tuffs expos immediately north—east of Cape Debunscha. The fossils were fou rincipally in the bottom beds (as is also the case at Etome) and agree vell with the forms collected by Dusén[1] from tha locality and later escribed by Menzel (1922). These fossils unfortunately do not permit n exact age determination of the tuffs since all species recorded are lentical with living forms. They do, however, suggest that the vulanicity is of fairly recent date. Besides the plant remains Dusén ecorded the presence of the recent gastropod *Achatina downesii* Gray 1894, p. 49).

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[1] GUILLEMAIN considered that he had discovered evidence for Cretaceous vulcanic at a locality »unterhalb Balangi». He reported a band of light-colored shale, which considered might be a tuff deposit, interbedded with Senonian limestones and sh and which yielded the following fossil plants: *Leguminosites albizzoides* Menzel, *A carpidium guillemaini* Menzel, *Combretiphyllum acuminatum* Menzel and *Phyllites* (MENZEL, 1909). Careful examination of this area by the author disclosed the prese of carbonaceous shales containing fragmentary plant remains, but these appear to of normal marine or estuarine origin.

[2] It is of interest to note that Mt. Cameroon, which has been dormant since 1 erupted in July, 1954.

The tuff at Etome, which has a fine texture and which is entirely ree from basalt fragments, rests partially on lateritic clay and partially n basalt (immediately north—east of Cape Nachtigall the author bserved a meter thick band of lateritic clay intercalated between wo lava flows). Concerning the tuff cliffs at Batoke, Dusén (1894, . 46) made the following statement (translated from the Swedish), Neither plant nor animal remains have been discovered in the tuff hat outcrops at Batoke, and which is perfectly horizontally situated n an open beach». I observed certain changes in the situation of the edding at nearby localities that resemble those at Debunscha, but vhich are of much lesser magnitude. The attitudes of various basaltic ragments in the bedding suggested to Dusén a marine origin for the tuffs.

At Cape Debunscha similar »projectiles» occur in the tuffs which, owever, dip moderately steeply, even if irregularly. The beds shown owermost in Fig. 4 belong to the »understa lagren» (lowermost beds) istinguished by Dusén (1894, p. 47), as opposed to the finer sediments at the top of the cliff. The beds are not horizontal, as at Batoke, ut are irregularly folded in such a manner as to suggest slumping. Vhether this has taken place on the surface during rapid deposition or lse under water is not possible to say. The clay beds exposed around 'iko are certainly of recent date and contain copal as well as poorly reserved fragments of possible vertebrate origin.

Concerning evidence for coastal uplift or sinking, Dusén thought t possible that the cliffs of Cape Debunscha might represent a tuff eposited under marine conditions or else the agglomeratic cone of a ubmarine volcano. This would account for an uplift of about 30 m. Ie also observed certain other signs such as a possible raised beach. saw nothing definite that could by regarded as positive evidence of ertical movements. Dusén (p. 47) mentioned that he was unable to pproach Cape Debunscha from the sea. This is now possible and there a narrow beach at the foot of the cliff (see fig. 4). This could be due a slight recent change of level, but has in all probability arisen from ie recent landslide of part of the face of the cliff.

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[1] Preserved in Riksmuseets Paleobotaniska Avdelning, Stockholm.

## Acknowledgements

The author wishes to thank Professor Per Thorslund, Paleontologiska Institutione Upsala, for his critical reading of the manuscript. The keeper of Geology, Britis Museum (Natural History) kindly permitted the fossil determinations to be carrie out in his department.

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# Correlation of the Scandinavian Middle Ordovician with th graptolite succession

By

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*Abstract.* A correlation of the Scandinavian Middle Ordovician shelly and graptoliti facies has been made based on new graptolite material and reinvestigation of most o the previous graptolite material of stratigraphic importance. The *Crassicauda* limeston is shown to be the equivalent of the subzone of *Climacograptus haddingi* instead of th zone of *Nemagraptus gracilis* as previously thought. Thus both the *Schroeteri* and *Crassicauda* limestones correspond to the Llandeilian. The main part of the *Ludibundus* limeston falls within the zone of *Nemagraptus gracilis*. It is impossible at present owing to insufficient material to use any graptolite zones for correlation between *N. gracilis* and *D clingani* beds.

## Introduction

Examination of most of the graptolite material on which the previous correlations between the Swedish Middle Ordovician limestone and graptolitic successions have been based has shown that some modification of current classifications must be made. These changes are necessitated partly by previous wrong determinations of some graptolites and partly in consequence of the use of both shelly and graptolite zones indiscriminately in the older correlations.

One of us (V. J.) has been engaged since 1945 on the study of the stratigraphy of the Middle Ordovician beds in Sweden and new graptolite material of stratigraphic importance has been obtained especially from the Siljan district and the Norra Skagen boring. The other (I. S.) has been describing the graptolite material from Jämtland and Tvären discussed by THORSLUND (1940) and has also had the opportunity of examining most of the other Swedish graptolite material involved in these correlations. As the publication of these studies may take some time, we have considered it desirable to publish separately the results bearing on the correlation of the Middle Ordovician of Scandinavia.

The term Middle Ordovician is used here in the same sense as by KIAER (1920) and JAANUSSON (1945, 1953) but in our opinion it must be defined in terms of the graptolitic sequence if it is to be recognized internationally. The best boundary in the graptolitic succession for use as the base of the Middle Ordovician in Europe seems to be that between the *Didymograptus* and *Dicellograptus* shales, *i. e.* between the zones of *Didymograptus murchisoni* and *Glyptograptus teretiusculus*, corresponding to the upper boundary of the Lower Ordovician as used by BULMAN (1938, p. D 61). In the Swedish shelly succession it corresponds to the boundary between the *Platyurus* and *Schroeteri* limestones[1] (in Estonia between the Aseri and Tallinna stages), and in Great Britain evidently to the base of Llandeilo as defined by WILLIAMS (1953). The upper limit coincides with the accepted boundary in Baltoscandia which corresponds roughly to the boundary between the zones of *Dicranograptus clingani* and *Pleurograptus linearis*. This definition of the Middle Ordovician for northern Europe must, however, be regarded as provisional as such stratigraphic decisions must be made by a more widely representative authority (cf. also STØRMER 1953, p. 44).

## Graptolite evidence

### *Oslo Region, Norway*

The graptolites found in the Middle Ordovician rocks of the Oslo Region have been recently listed by STØRMER (1953) from determinaions made by BULMAN.

$4a\alpha_3$ — the *Ogygiocaris* shale. This division in the Oslo Region is ocally rather rich in graptolites but in the older collections it has not isually been distinguished from the other parts of the *Ogygiocaris* group nd therefore the exact horizon of the graptolites is generally unknown. Among graptolites found in this division STØRMER (1953, p. 58) has nentioned *Janograptus laxatus* TULLBERG and *Glossograptus hincksi* HOPKINSON) indicating the *Glossograptus hincksi* subzone of Sweden.

$4a\alpha_4$ — the *Trinucleus bronni* beds. *Dicranograptus irregularis* HADDING has been found in these beds (STØRMER 1953, p. 61) and from he same beds BULMAN (1953) has described *Gymnograptus linnarssoni* MOBERG). The association of both these species points to the *Climacoraptus haddingi* subzone in Sweden (cf. also STØRMER 1953).

$4b\alpha$ — the Lower *Chasmops* shale. At Glegeden, Asker, some graptotes have been found in these beds (STØRMER 1953, p. 64) and determined by BULMAN as: *Climacograptus scharenbergi* LAPWORTH, *Diplograptus molestus* (type of HADDING, not of THORSLUND), *Climacograptus* sp. and *Amplexograptus* aff. *arctus*. The assemblage indicates, according to BULMAN, the *Diplograptus molestus* zone (cf. STØRMER 1953, p. 64). All these species, however, occur also in the *Nemagraptus gracilis* zone and these beds may, therefore, easily belong to the *Nemagraptus gracilis* zone.

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[1] It may be noted here that previously the boundary between the Lower and Middle rdovician (or *Chasmops* beds and Orthoceratite limestone) has in Sweden been often rawn between the *Schroeteri* and *Crassicauda* limestones (cf. for ex. THORSLUND 1948 and 1948 b) based on the general assumption that the *Crassicauda* limestone (or »Flagalk») is contemporaneous with the zone of *Nemagraptus gracilis*. STØRMER (1953), on ne other hand, has proposed a much lower position of the boundary between the Lower nd Middle Ordovician, namely between the *Endoceras* limestone (3 cγ) and the *Ogygioaris* group (4 a), this boundary being marked in the Oslo Region by a change from the mestone to the shale facies. It is, however, at present unknown if this boundary coresponds to a limit between the graptolite zones and also where the exactly corresponding vel in the Swedish and Estonian limestone succession lies.

The *Ampyx* limestone (4a$\beta$) has not yielded any determinable graptolites, as is the case also with the upper part of the *Chasmops* group (4b$\beta$—4b$\delta$).

*Sweden.*

In the *Schroeteri* limestone of Öland BULMAN (1932 a, b) has described four species of graptolites, three of which have not as yet been found elsewhere and one (*Climacogr. scharenbergi*) has a long vertical distribution.

In the boring at Norra Skagen, Kinnekulle, *Glossograptus hincksi* (HOPKINSON) has been found at the level of 28,47 m, in the lowest layers of the *Schroeteri* limestone, 89 cm above the boundary between the *Platyurus* and *Schroeteri* limestones. Higher up in the same boring at the level of 25,18 m, in the lowermost beds of the *Crassicauda* limestone *Dicellograptus divaricatus salopiensis* ELLES et WOOD and *Gymnograptus linnarssoni* (MOBERG) have been found.

In the *Crassicauda* limestone (»Flagkalk») of Siljan district, Dalarna TÖRNQUIST (1911) described *Hallograptus bimucronatus* (NICHOLSON) and *Glyptograptus teretiusculus* var. and the same species have been determined by JAANUSSON (1947). Reinvestigation of the TÖRNQUIST's original specimens and new, partly »isolated» material (cf. fig. 1) however, has shown that the specimens previously determined as *Hallograptus bimucronatus* belong to *Gymnograptus linnarssoni* (MOBERG). This species seems to be not very rare in the *Crassicauda* limestone of the Siljan district and has been found in three localities. At Vikarbyn, a specimen has been found 7,35 m from the lower boundary of the *Schroeteri* limestone and at Fjäcka several specimens come from a limestone bed c. 3,75 m below the boundary between the *Crassicauda* and *Ludibundus* limestones.

On Andersön, Jämtland, the allochthonous *Ogygiocaris* shales are locally rather rich in graptolites. HADDING (1912, 1913) divided the shales into two subdivisions, each corresponding to one graptolite zone. The Lower *Ogygiocaris* shale belongs to the subzone of *Climacograptus haddingi* and contains, according to him, 7 graptolite species including *Climacograptus haddingi* GLIMBERG (*C. putillus* in HADDING together with *i. a. Ogygiocaris dilatata sarsi* Ang., *Trinucleus bronni* (Sars et Boeck) (*Tr. coscinorhinus* in Hadding), *Pseudomegalaspis patagiata* (Törnq.) and *Telephus bicuspis* Ang.

The Upper *Ogygiocaris* shale contains *Dicellograptus sextans exilis* Elles et Wood and *Nemagraptus gracilis remotus* Elles et Wood and belongs to the zone of *Nemagraptus gracilis.* In the lowest part of the shale these species occur together with *Ogygiocaris dilatata sarsi* Ang.

At Killeröd in SE Scania, according to Nilsson (1951), the beds with *i. a. Trinucleus bronni* (Sars et Boeck), *Pseudomegalaspis patagiata* (Törnq.) (cf. Jaanusson 1953, p. 459) and *Telephus granulatus* Ang. are underlain by shale containing graptolites of the zone of *Climacograptus haddingi.* No graptolites have been found in the *Trinucleus bronni* beds themselves.

According to Lindström (1953), the Sularp shale in Scania, containing *i. a. Dicranograptus ziczac* Lapw., overlies the shales belonging to the zone of *Nemagraptus gracilis.*

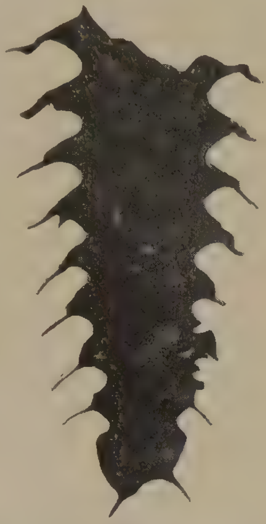

Fig. 1. *Gymnograptus linnarssoni* (Moberg). An »isolated» specimen from the *Crassicauda* limestone of Fjäcka, Siljan district, c. 3,75 m from the lower boundary of the *Ludibundus* limestone. Coll. Jaanusson 1947. Obverse aspect. × 12. Photo N. Hjorth.

In the boring at Kullatorp, Kinnekulle, Thorslund (1948 a) recorded the occurrence of *Dicranograptus ramosus* (Hall) in the lowest part of the core. A reexamination of this specimen, however, showed it to be specifically indeterminable. Using the vertical distribution of the ostracod *Pyxion carinatus* (Hadding) in the boring and in Scania (Hadding 1913), Thorslund tentatively drew the boundary between the zones of *Nemagraptus gracilis* and *Diplograptus molestus* in the Kullatorp core at about the level of 77,0 m and supposed this boundary to coincide roughly with the boundary between the *Crassicauda* and *Ludibundus*[1] limestones. A reinvestigation of the Kullatorp core has, however, shown that the boundary between the *Crassicauda* and *Ludibundus* limestones lies about 10 m lower, at the level of 87,40 m.

In Tvären, Södermanland, a few graptolites have been obtained from limestone boulders which according to other fossils belong to the lowermost part of the *Ludibundus* limestone. Of these graptolites only *Dicellograptus divaricatus salopiensis* Elles et Wood can be placed stratigraphically and indicates the zone of *N. gracilis* or an even lower level.

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[1] Previously called the Lower or Older *Chasmops* limestone, cf. Jaanusson 1951.

In Jemtland, two graptolite faunas can be recognized below the Slandrom limestone (Thorslund 1940). The upper one is characterized by *Dicranograptus clingani* Carr., *Climacograptus caudatus* Lapw. and *Neurograptus margaritatus* (Lapw.) indicating the zone of *Dicranograptus clingani*. The lower beds yield *Climacograptus scharenbergi* Lapw. and *Glyptograptus euglyphus* Lapw. amongst other forms and cannot represent a horizon much below that of *Dicranograptus clingani*.

In the boring at Kullatorp, Kinnekulle, limestone beds containing *i. a. Asaphus glabratus* Ang. and *Phillipsinella* cf. *parabola* (Barr.) are overlain by shales containing *Dicranograptus clingani* fauna (Thorslund 1948 a).

## Correlation of the graptolite succession

The standard graptolitic succession in Sweden is that in Scania and this has been used as the basis of the correlation between the shelly and graptolitic facies. The usual succession of the Middle Ordovician in Scania is that described by Hadding (1913, 1915 a, b) and is in descending order as follows:

Zone of *Dicranograptus clingani*
» » *Amplexograptus vasae*
» » *Diplograptus molestus* (*Climacogr. rugosus* Tullberg in Hadding)[1]
» » *Nemagraptus gracilis*
» » *Climacograptus haddingi* (*Climacogr. putillus* Hall in Hadding)[2]
» » *Glossograptus hincksi*

More recent work includes papers by Ekström (1937, z. of *Glossogr. hincksi*), Hede (1951, *Glossogr. hincksi* — *Nemagr. gracilis*), Nilsson (1951, z. of *Climacogr. haddingi*) and Nilsson (1953, passage beds above *Nemagr. gracilis*). Hede (1951) in his description of the boring at Fågelsång has used *Gymnograptus linnarssoni* as his zonal index for the lowest beds of the *Dicellograptus* shale instead of *Glossograptus hincksi*. Earlier writers (Linnarsson 1879, Tullberg 1883, Moberg 1910) have distinguished a zone of *Gymnograptus linnarssoni* between the zones of *Glossograptus hincksi* and *Climacograptus haddingi* (»pu-

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[1] Cf. Thorslund 1948 a, p. 370.
[2] Cf. Glimberg 1952.

*tillus*») which HADDING did not differentiate. As *Gymnograptus linnarssoni* is recorded by HADDING and HEDE (1951, cf. table 4) from both *Glossogr. hincksi* and *Climacogr. haddingi* zones it is difficult to see why HEDE should use the name for the lower zone only. *Glossograptus hincksi* seems in Scandinavia to be confined to the lower part of these beds and is therefore a good index fossil.

NILSSON (1953) has noted the occurrence of a mixed fauna including forms usually regarded as typical of either the zone of *Nemagraptus gracilis* or of *Dicranograptus clingani*. Unfortunately the exact horizon of this fauna cannot be determined. He considers that *Diplograptus molestus* is not suitable as a zone fossil since it occurs abundantly in the zone of *Nemagraptus gracilis* (cf. HEDE 1951, table 4).

A comparison of faunal lists of the *Glossogr. hincksi* and *Climacogr. haddingi* beds shows only little difference between them and for purposes of broad correlation it seems better to regard them as subzones constituting together one graptolite zone. As this zone corresponds exactly in position to the wellknown British zone of *Glyptograptus teretiusculus* it seems best to use this name provisionally in Sweden also.

HADDING's zones of *Diplograptus molestus* (»*rugosus*») and *Amplexograptus vasae* were based on isolated occurrences of these species which are now known to occur abundantly in the beds above or below and there is at present no characteristic graptolite fauna known for these zones. This may be due to the occurrence of beds on this horizon in Scania with only a few long-ranging graptolites. NILSSON's (1953) peculiar mixed fauna suggests, however, that there may be only a transition fauna between the *Nemagr. gracilis* and *Dicranogr. clingani* zones.

Subzone of *Glossograptus hincksi*. The graptolites from the *Ogygiocaris shale* (4a$\alpha_3$) of the Oslo Region indicate clearly the subzone of *Glossogr. hincksi* (STØRMER 1953). Swedish records of graptolites characteristic of this subzone are few outside of Scania. The occurrence of *Glossograptus hincksi* at the bottom of the *Schroeteri* limestone in the Norra Skagen bore confirms the correlation of the *Schroeteri* limestone and *Ogygiocaris* shale (4a$\alpha_3$) based on their trilobite faunas. In the allochthonous sequence of Andersön, Jämtland, the beds corresponding to the zone of *Glossogr. hincksi* must form a part of the limestone immediately below the *Ogygiocaris* shale as the lower part of the shale there contains the *Climacogr. haddingi* fauna.

Subzone of *Climacograptus haddingi*. The *Trinucleus bronni* beds of the Oslo Region evidently belong to this subzone (STØRMER 1953) and the same is the case with the Lower *Ogygiocaris* shale of Andersön (HADDING 1912, 1913) which also includes *Trinucleus bronni* (SARS

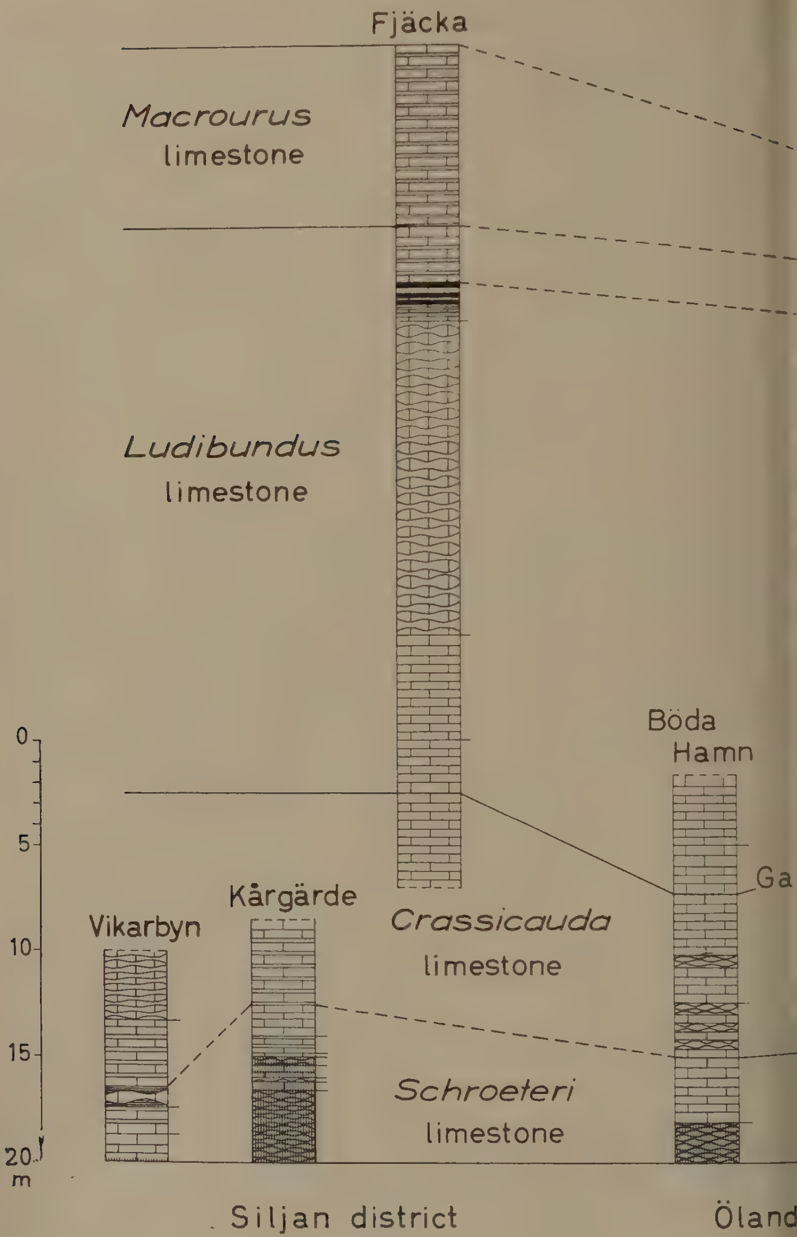
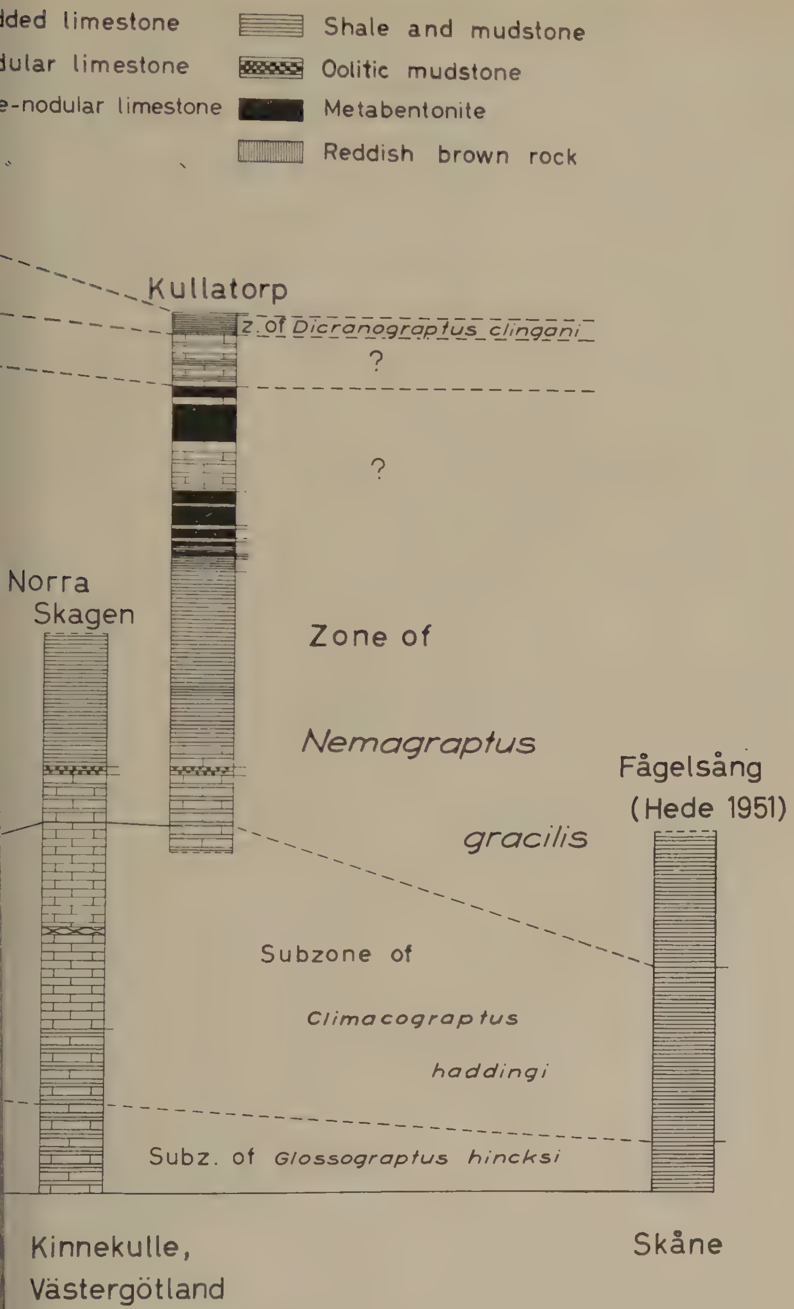


Fig. 2. Correlation of sections from the Siljan



m Öland, Västergötland and Skåne (Scania).

& Boeck). At Killeröd in SE-Scania the *haddingi* beds are followe by beds with *Trinucleus bronni* (Nilsson 1951) but there is no direc evidence to suggest that these *bronni* beds belong to a higher graptolit zone (cf. also Størmer 1953, pp. 132—133).

The *Crassicauda* limestone has usually been correlated with the zon of *Nemagraptus gracilis* (Törnquist 1911, p. 425, Troedsson 1928 p. 179, Bulman 1936, p. 12, Jaanusson 1947, Thorslund 1948 a based on the determination of *Hallograptus bimucronatus* (Nich.) b Törnquist (1911) from the limestone in the Siljan district. Since a noted above, reexamination has shown that this is a misidentificatio of *Gymnograptus linnarssoni* (Moberg), there is no evidence to sugges that the *Crassicauda* limestone is a high as the zone of *Nemagr. gracili* and it more probably represents the subzone of *Climacograptus haddingi*. It may be noted that Öpik (1927) records *Gymnograptus linnarssoni* from the contemporaneous Uhaku beds ($C_{1c}$) of the Estonia succession and correlates these beds with the zone of *Climacogr. haddingi* (»*putillus*») (Öpik 1930, p. 20).

On the supposition that the *Crassicauda* limestone was contemporaneous with the zone of *Nemagr. gracilis*, it has usually been correlate with the *Ampyx* limestone (4a$\beta$) in the Oslo Region. The occurrenc of *Gymnogr. linnarssoni* in the *Crassicauda* limestone makes it mor likely that it has to be correlated with the *Trinucleus bronni* bed (4a$\alpha_4$). Furthermore, the trilobite fauna of the *Ampyx* limestone i quite unlike that of the *Crassicauda* limestone and contains species *i. a. Ampyx costatus* (Boeck), which are characteristic for the *Ludibundus* limestone. On the basis of the trilobite fauna the *Ampyx* limestone has been correlated by Jaanusson (1951) with the lowermos *Ludibundus* limestone.

Zone of *Nemagraptus gracilis*. There is very little direct evidenc of the zone of *Nemagr. gracilis* in the shelly facies in Scandinavia. Sinc in Scania the bentonitic complex in the upper part of the *Ludibundu* limestone (Sularp shale, Lindström 1953) is directly underlain b shales with the *Nemagr. gracilis* fauna, the *Ludibundus* limestone belov the bentonite beds must belong to the *Nemagr. gracilis* zone (Lindström 1953). From the occurrence of *Pyxion carinatus* in the Kullator bore, a species which occurs in Scania in the *Nemagr. gracilis* beds an those immediately above (Hadding 1913), Thorslund (1948 a) dre a boundary between the zones of *Nemagr. gracilis* and *Diplogr. molestu* in the core. According to the reexamination of the fauna in the bo mentioned above the boundary between the *Crassicauda* and *Lud bundus* limestone lies some 10 m lower. Thus here too a considerab part of the *Ludibundus* limestone must belong to the zone of *Nemag*

**Correlation table of Middle Ordovician in Baltoscandia**

The Estonian succession (not discussed in the present paper) according to JAANUSSON 945).

| Estonia | Shelly facies, Sweden | Oslo Region, Norway | Graptolite succession, Scania |
|---|---|---|---|
| $D_3$ Vasalemma | *Macrourus* | 4bδ Upper *Chasmops* limestone | Zone of |
| $D_2$ Keila | | | *Dicranograptus clingani* |
| $D_1$ Jõhvi | | 4bγ Upper *Chasmops* shale | ? |
| | | 4bβ Lower *Chasmops* limestone | ?<br>Zone of |
| $C_3$ Idavere | *Ludibundus* | 4bα Lower *Chasmops* shale | *Nemagraptus gracilis* |
| $C_{II}$ Kukruse | | | |
| | | 4aβ *Ampyx* limestone | |
| $C_1$c Uhaku | *Crassicauda* | 4aα₄ *Trinucleus bronni* beds | Subzone of *Climacograptus haddingi* |
| $C_1$b Tallinna (»Lasnamäe») | *Schrocteri* | 4aα₃ *Ogygiocaris* shale | Subzone of *Glossograptus hincksi* |

*racilis* which is in full agreement with the evidence from Scania. It is nteresting to note that ÖPIK (1928, 1930), in consequence of his discov- ry of *Gymnograptus linnarssoni* in the Uhaku beds mentioned above, orrelated the Estonian equivalents of the *Ludibundus* limestone with he zone of *Nemagraptus gracilis.*

There is no evidence at all on which to base the position of the boundary etween the zones of *Climacogr. haddingi* and *Nemagraptus gracilis* n the limestone succession but it is tentatively put at the junction etween the *Crassicauda* and *Ludibundus* limestone. The upper limit f the *Nemagr. gracilis* zone is even more vague since the status of he »*Diplogr. molestus*» zone is uncertain at present. POULSEN (1936) as recorded the occurrence of *Diplograptus törnquisti* HADDING on ornholm in beds which according to GRY (1951) lie above the main entonite beds there. As this species seems in Scania to be restricted o the zone of *Nemagr. gracilis* (HADDING 1913) at least the lower part f the bentonite beds too may belong to the zone of *Nemagr. gracilis.*

Zone of *Dicranograptus clingani.* The *clingani* fauna occurs above ne *Ludibundus* limestone in the Kullatorp core (THORSLUND 1948) nd in the Brunflo-Lockne area, Jemtland, it is found below the Slan- rom limestone (THORSLUND 1940). The upper limit of the Middle rdovician can therefore be rather easily defined in both the shelly nd graptolitic facies. The lower boundary of the *Dicranogr. clingani* zone, however, cannot be satisfactorily defined at present. In Scania and in the limestone successions, graptolites are scarce and usually long-ranging forms in the beds between *Nemagr. gracilis* and *Dicranogr. clingani* zones and although a distinct fauna can be recognized in the Brunflo-Lockne area immediately below *Dicranogr. clingani* beds, it cannot be correlated with either of HADDING's zones of *Diplogr. molestus* and *Amplexograptus vasae* from Bornholm both of which are, in any case, of very doubtful value. THORSLUND's (1940, 1948 a) correlation of at least the upper part of the *Macrourus* limestone with the zone of *Dicranogr. clingani* appears to be well founded but its lower boundary with the *Ludibundus* limestone cannot at present be fixed on any graptolitic scale.

### Comparison of the Middle Ordovician graptolite zones in Scania and Great Britain

One of the chief difficulties in the correlation of the Middle Ordovician is that the graptolite faunas of Sweden and Great Britain are at first sight rather dissimilar. The zone fossils used in Britain do not appear to be common in Sweden and the Swedish indices are long-range forms in Britain if they are known at all. Another major difficulty is that the upper part of the graptolite succession in Britain is based on the Scottish development, which, in the purely graptolitic facies at least, has no representatives of graptolitic beds between the Arenig and the zone of *Nemagraptus gracilis*. In Wales, however, there is a much fuller succession of beds between these horizons but no detailed systematic work on the graptolites has yet been done comparable to that on the *Didymograptus* shale of Sweden.

ELLES (1940, p. 411) has pointed out that in the Builth district »there commonly appears to be a definite palaeontological break at the top of the zone of *Didymograptus murchisoni*» and a comparable faunal change has been recorded from Scania at the boundary of the *Didymograptus* and *Dicellograptus* shales. The beds above this »break» and below the zone of *Nemagr. gracilis*, *i. e.* the zone of *Glyptograptus teretiusculus*, evidently correspond to the subzones of *Glossogr. hincksi* and *Climacogr. haddingi* in Scania. The graptolite fauna of this zone is at present much better known in Scania (HADDING 1913, EKSTRÖM 1937, HEDE 1951) than in Britain where shelly faunas are frequently found at this level.

There appears to be little difficulty in the correlation of the zone of *Nemagr. gracilis* although the typical form appears to be rarer in Sweden than in Britain.

It is impossible at present to correlate the graptolite zones between hose of *Nemagr. gracilis* and *Dicranogr. clingani* in Sweden and Britain wing to the lack of corresponding diagnostic forms and the parallelism een in some recent correlation tables is merely the obvious subdivision ssuming that there is a complete succession in both areas. It may be nentioned, however, that the zones of *Climacogr. peltifer* and *Climacogr. vilsoni* of the Scottish succession appear to be replaced by the single *iplogr. multidens* zone in Wales and that there is probably a corresponding single fauna in Sweden instead of HADDING's two zones. oth the zones of *Climacogr. peltifer* and *Climacogr. wilsoni* can be regarded as passage zones between the faunas of *Nemagr. gracilis* and *icranogr. clingani* according to ELLES (1937), and NILSSON's (1953) nixed fauna from Scania appears to indicate the presence of passage eds there also.

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# Stora Bjers-fyndet i relation till några andra fynd från äldre stenåldern på Gotland

Av

HENR. MUNTHE

I Gotlands Allehanda för den 2 oktober har landsantikvarien Greta Arwidsson lämnat intressanta meddelanden rörande ett i Stenkyrka s:n jort högst märkligt fynd, en från äldre stenåldern stammande grav nnehållande ett för denna tid i typisk s. k. sovställning med långt ppdragna ben försett skelett. Hon anser, att fyndet gott kan konurrera med »kvinnan från Bäckaskog», vars monter är utställd i nuseum i Stockholm. Detta fynd är avbildat i det ståtliga verket 'iotusen år i Sverige (1), fig. 24, och meddelas här i förminskning såom fig. 1 jämte gravgåvor av en nätsticka och en fågelpil (se fig. 2). skelettets från Stora Bjers bäcken är inkilad spetsen av en fågelpil, ch därintill funnos några små flintfragment — mikroliter — vilka uttit i skåror i spetsens sidor.[1] Vidare meddelas bl. a., att kraniet av en där jordade »urguten» är mycket välbehållet och rundkulligt med ög hjässa, som dock delvis är krossad, vilket tyder på, att han dräpts, nnan han lades i graven. Mannen antages ha jordats på en backe vid rättare något innanför) den dåtida stranden, som beräknas ha legat a 40 meter över havet, och fyndet, vars ålder uppskattas till sex à u tusen år, anses vara det äldsta i sitt slag på Gotland och måhända t av de äldsta fynden i Sverige. Även rasbiologiskt anses fyndet få et största värde. Graven med fyndet har införts till Gotlands Fornl.

Enär detta märkliga fynd är av stort intresse även ur geologisk ynpunkt, torde en kort redogörelse för vad hittills är känt rörande

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[1] Fågelpilar äro funna flerstädes på svenska fastlandet, lokalt i stort antal i Skåne. rån Gotland är, såsom ARWIDSSON nämner, förut blott ett sådant fynd — i två exemplar an flintspånor i behåll — känt, nämligen från Ancylusgrottan »Stora Förvar» på Stora arlsö (7). Såsom jag vid ett föregående tillfälle (6) sid. 225, alternativt framhållit, torde ssa pilar ha ditkommit sekundärt — rättare sagt såsom medförda reliker — i kulturgret, vilket dateras till döstid. Den möjligheten torde dock kunna föreligga, att grot- har varit bebodd under senare delen av Maglemosetid, då, såsom vi skola se, några tser på huvudön voro befolkade och invånarna ha kunnat taga sig över till Stora arlsö, liksom de förut på sina enkla farkoster ha kommit till Gotland, måhända föregna av invandrare redan under Rhabdomematid, då enligt ERIK NILSSON (3) Gotland r landfast med södra Sverige. Någon nätsticka har däremot ännu icke träffats på Gotd, men det kan förtjäna nämnas, att ett fynd av en sådan beskrivits från av Litorinalera erlagrad Ancyluslera (2), ett fynd som på sin tid torde ha varit ett av de äldsta i vårt d kända av människohand bearbetat föremål från Maglemosetid.

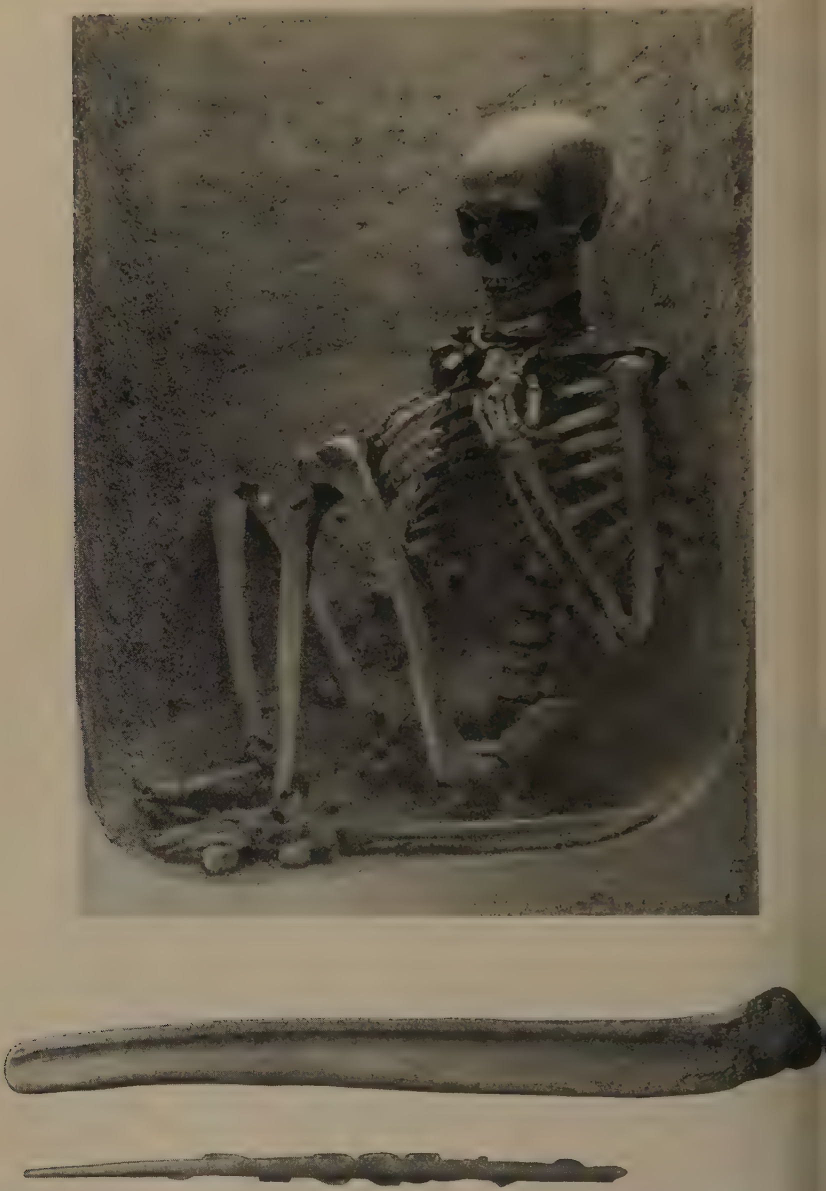


Fig. 1. Sveriges förut äldsta kända gravfynd. Barum, Bäckaskog, NÖ Skåne. Gra
gåvor ($^1/_3$): en nätsticka och en fågelpil nedtill på bilden. Efter Statens Historis
Museum. Tillväxt 1930.

några andra fynd på Gotland från den nordiska äldre stenålderns förr
s. k. Maglemosetid vara motiverad. Denna tids mellersta del motsv

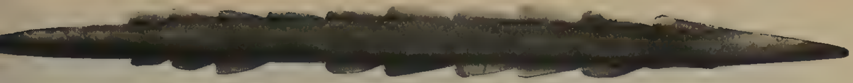


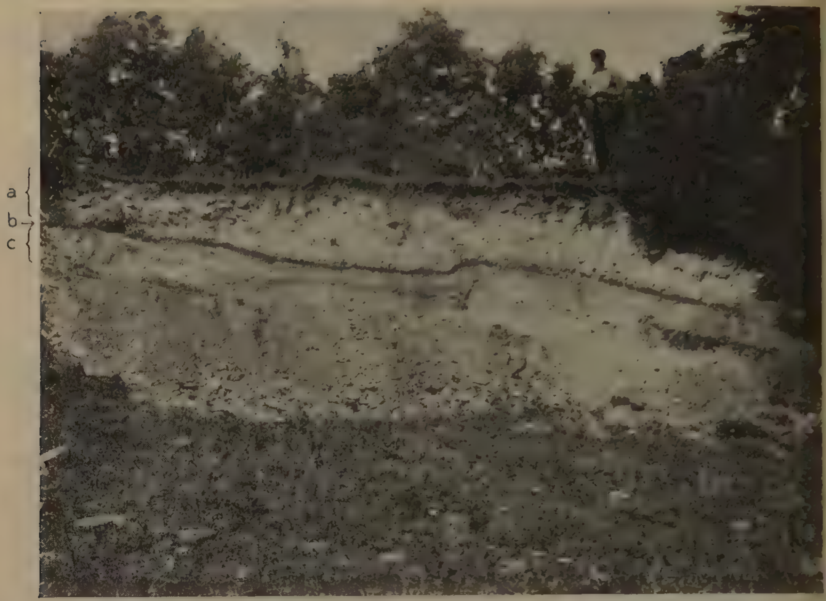
Fig. 2. Fågelpil ($^3/_5$) från Skåne. Statens Historiska Museum. Vägledning 1923.

ar Ancylustid, som jag (6), Tavl. VII, fig. 8 beräknat ha räckt mel-
an 7 500 och 5 800 f. Kr., d. v. s. från Ancylussjöns efter det svagt
alta Rhabdonemahavets tid följande transgression upp till A.G. då
– drygt 7 000 år f. Kr. — insjöns karakteristiska molluskfauna hade
nvandrat.

Tre sådana fynd äro hittills kända. Det första gjordes nära Svalings
ård i Gothems s:n av framlidne extrageologen A. Hj. Olsson år 1911
ch offentliggjordes samma år (4), det andra i ordningen av mig 1928
id Gisslause gård i Lärbro s:n och undersöktes 1929 av mig och antikva-
ien Hans Hansson samt beskrevs av oss 1930 (5), det tredje slutligen
v framlidne förmannen G. Gytare vid A.-B. Strå kalkstenbrott i
Bunge s:n samt undersöktes 1936 under ledning av professor M. Sten-
berger och mig. Det därvid insamlade materialet har dock ännu icke

Munthe foto. 1911.

ig. 3. Profil visande kulturlagrets (K) vid Svalings läge mellan ancylusgrus (A-gr.) och litorinagrus (L-gr.).



Munthe foto. 1929.

Fig. 4. Lagerföljden vid Gisslause. Grustagets östra del. a = litorinagrus. b = kulturlagret. c = rullstensgrus. Nedanför detta nedrasat material.

bearbetats, men fyndet har i korthet omnämnts i tryck vid några tillfällen.

Dessa tre fynd utgöras av tunna kulturlager, av vilka de vid Svalings och Strå vila på strandgrus, som avsatts av Ancylussjön och överlagras av strandgrus, avsatt av det därpå följande Litorinahavet (se fig. 3), medan kulturlagret vid Gisslause ligger på rullstensgrus och överlagras av Litorinagrus (se fig. 4). Kulturlagret vid Strå ligger omedelbart under Litorinahavets högsta gränsvall, de båda andra åter några meter lägre än denna. Samtliga innehålla kol och tillslagna flintverktyg av med landisen hitfört material av undersilurisk ålder samt verktyg av ben, och av övriga fynd framgår, att folkets »matsedel» bestått av bl. a. gråsäl, rådjur?, hare, fåglar, fiskar (sarv, mört och gädda), landsnäckor, hasselnötter m. m. I kulturlagret vid Svalings har vid senare utförda undersökningar i Litorinalagret träffats ett av docent ELIAS DAHR bestämt fragment av människo-kranium, vilket kan härstamma från kulturlagret, varifrån det i så fall upprivits av det transgredierande Litorinahavets vågor. I det från Gisslause har HANSSON urskilt några olika, slagna flintföremål, bl. a. små spånor, vilka han anser möjligen ha suttit i fågelpilar av trä.

Beträffande de omnämnda fyndens ålder utgår jag ifrån den allmänt antagna förutsättningen, att Nordens Maglemosetids folk har varit jägare och fiskare, vilka levat huvudsakligen vid stränderna av hav resp. insjöar. Då nu Stora Bjers-mannen, såsom ARWIDSSON, säkerligen med rätta, anser sannolikt, har jordats vid stranden och c:a 40 meter över havsytan, har denna strand varit Ancylussjöns markerade högsta gränsvall, som framgår nära utanför fyndplatsen, och vars krön litet sydväst om denna av mig avvägts till 40,3 m ö. h., enligt den i mitt arbete 1910 (8) meddelade kartan i skalan 1 500. Graven ligger alltså vid 100 procent av A.G. (Ancylusgränsen), och dess ålder kan enligt min mening [se (6) Tavl. VII, diagram 8] dateras till omkring 7 000 år f. Kr., en siffra som måhända är i överkant, medan ARWIDSSONS siffror 6 000 à 7 000 år (d. v. s. före vår tid), är i påtaglig underkant. I »Tiotusen år i Sverige» (1) dateras Barumfyndet till Ancylustid, som där beräknas falla mellan 7 000 och 5 000 f. Kr. Stora Bjers-fyndet gör det sannolikt, att även Barumfyndet kan dateras till A.G.-tid, alldenstund detsamma även är beläget vid A. G., här c:a 11 m ö. h. Se (6) Tavl. X (kartan över Ancylussjön), på vilken, NO om Kristianstad, tecken också för de båda slagen av gravgåvor äro inlagda. Jfr f. ö. sid. 221, där jag tar avstånd från RYDBECKS datering av bl. a. Barumfyndet till hällkisttid, men jag anser »troligare vara från Maglemosetid».

Ifråga om de tre kulturlagrens ålder ställer sig saken på ungefär följande vis. Vid Strå ligger A.G. enligt min avvägning 1936 41,5 m och kulturlagret 25 m ö. h., varför detta tillkommit, när A.G.-stranden hade förskjutits med ett belopp av 16,5 m, d. v. s. till 60 procent av A.G., vilket enligt min beräkning [se (6) ovan anförda diagram] skulle innebära, att kulturlagret här tillkommit omkring 6 300 f. Kr. Ancylusstrandens negativa förskjutning har sedan fortsatt med ett belopp, som enligt relationsdiagrammet för baltiska trakter, Tavl. XVI (6) fig. 1 och 3, vid Stora Bjers torde ha uppgått till minst 20 m ö. h. och, såsom i det följande visas, ännu något längre, men till vilken lägsta nivå dock ovisst. Litorinahavets högsta nivå (L.G.) ligger vid Strå 26,5 m ö. h., och den gränsvall, som täcker kulturlagret här, har vid denna Litorinatidens saltaste skede, c:a 4 500 f. Kr., avsatts här först c:a 1 800 år efter kulturlagrets tillkomst.

Vid Svalings-fyndorten, där A.G. ligger c:a 32, L.G. c:a 20,5 och kulturlagret c:a 17 m ö. h., äro motsvarande siffror följande: Ancylussjöns negativa förskjutning c:a 15 m, d. v. s. kulturlagret vid 53 procent av A.G., dess ålder drygt 6 000 f. Kr. och L-transgressionen här c:a 500 år senare, d. v. s. något efter början av Litorinatiden (senu lato), av mig [anf. st. (6)] benämnd Mastogloia-Clypeustid, då salthalten ännu var låg, något som återspeglas av den härvarande molluskfaunan.

Vid Gislause-fyndorten slutligen, där A.G. ligger 37, L.G. c:a 23 och kulturlagret i medeltal c:a 18 m ö. h. har Ancylussjöns negativa strandförskjutning alltså uppgått till drygt 19 m, d. v. s. till c:a 48 procent av A.G. och kulturlagrets ålder varit c:a 6 000 år f. Kr. samt L-transgressionen ägt rum c:a 500 år senare, eller liksom vid Svalings under Mastogloia-Clypeustid.

Det skall givetvis bliva av mycket stort intresse att få veta resultatet av den åldersbestämning, vartill den i Arwidssons meddelanden nämnda radioaktiva undersökningen eventuellt kommer.

Min artikel nedskrevs kort efter mottagandet (den 3 oktober) av redogörelsen i Gotlands Allehanda och sändes snart därefter till Redaktören av G. F. F. jämte några av klischéerna. Som ett par andra sådana hade råkat komma på villovägar, men senare återfunnits, har artikeln — i något utvidgad form — kunnat inflyta först i detta häfte av tidskriften.

Till sist riktar jag mitt tack till Statens Historiska Museum för det genom antikvarien Erik B. Lundbergs benägna förmedling bekomna lånet av samtliga klischéer.

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# Synchronization of Late Glacial events New England and the Baltic region

By

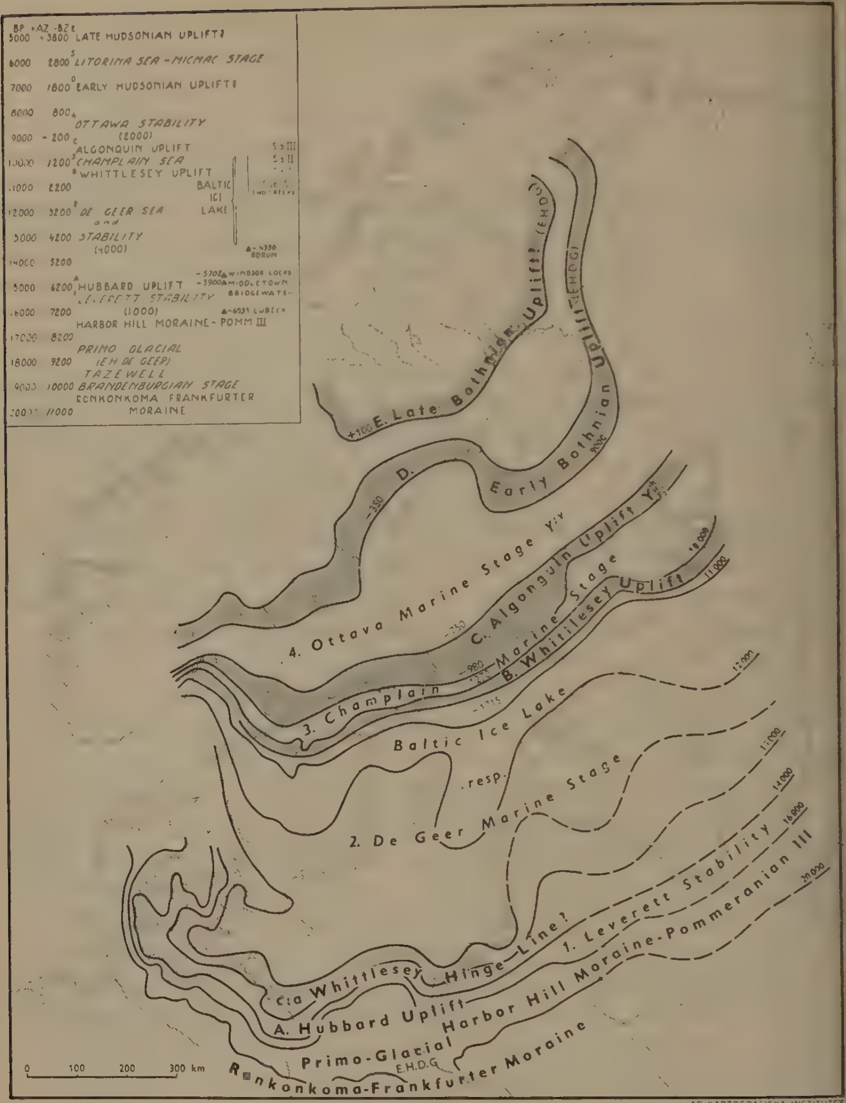
EBBA HULT DE GEER

Professor R. J. LOUGEE, Clark University, Worcester, Mass., has put up what he calls a Tectonic Chronology, based on a minute study of the land elevation following closely after the gradual disappearance of the ice cover, mainly by his own investigations concentrated to the region of New England. Other data available were in first hand the main morainic systems, already for the last half century well known through a generally very careful mapping by earlier geologists. The same is due regarding the extensive systems of ice-dammed lakes, comprising the big and long-lasting Lake Agassiz in the far West, the Central Great Lakes and others extending along the ice-border far into Canada, and, in New England, mainly narrow, elongated ice-dammed lakes in the Hudson and Connecticut River valleys.

The succession of moraines, lakes and land deformation Lougee has systemathised, and thereby found an alternate series of uplifts with intervals of stability. His scheme comprises five zones of stability and five periods of uplift, all of them named for prominent geologists. The former are marked by marine water planes, more or less inundating present land, namely: The Leverett Marine Stage, mainly in the present Long Island Sound, the De Geer Marine Stage, inundating the New England coast-land, The Champlain Sea and the Ottawa Marine Stage, both these latter with salt water entering from the St. Lawrence Valley, and, finally, the Micmac Marine Stage, which he refers to the Litorina.

The movements of uplift are found to start simultaneously along very elongated zones of elasticity in the earth's crust, called hinge lines and mapped out each of them with a continental semi-latitudinal extension and also, each of them, at a considerable distance south of the zone where the elevation finally sets in with its maximum force.

Compared with Sweden, the succession of events on the American side is easy to correlate (Fig. 1), only that the hinge lines are a pheno-


BP +AZ -BZ
5000 +3800 LATE HUDSONIAN UPLIFT?
6000 2800 LITORINA SEA - MICMAC STAGE
7000 1800 EARLY HUDSONIAN UPLIFT?
8000 800 OTTAWA STABILITY (2000)
9000 - 200 ALGONQUIN UPLIFT
10000 1200 CHAMPLAIN SEA
WHITTLESEY UPLIFT
11000 2200
BALTIC ICE LAKE
12000 3200 DE GEER SEA and STABILITY (4000)
13000 4200
14000 5200
S s III
S s II
- 4350 RÖRUM
- 5702 WINDSOR LOCKS
- 5900 MIDDLETOWN
BRIDGEWATER
15000 6200 HUBBARD UPLIFT
LEVERETT STABILITY (1000)
16000 7200
- 6951 LUBECK
HARBOR HILL MORAINE - POMM III
17000 8200
PRIMO GLACIAL (E H DE GEER)
18000 9200
TAZEWELL
19000 10000 BRANDENBURGIAN STAGE
RONKONKOMA FRANKFURTER MORAINE
20000 11000
E. Late Bothnian Uplift? (EHDG)
Early Bothnian Uplift (EHDG)
D.
4. Ottava Marine Stage Y
C. Algonquin Uplift Y
3. Champlain Marine Stage
B. Whittlesey Uplift
Baltic Ice Lake
resp.
2. De Geer Marine Stage
c:a Whittlesey Hinge Line?
1. Leverett Stability
A. Hubbard Uplift
Harbor Hill Moraine-Pommeranian III
Primo-Glacial E.H.D.G.
Ronkonkoma-Frankfurter Moraine
+100
-350
-750
-960
-1715
9000
10000
11000
12000
13000
14000
16000
20000
0 100 200 300 km

AB KARTOGRAFISKA INSTITUTET

Fig. 1. American stages of stability and uplift transferred to the Baltic region, as synchronized by dates of G. De Geer's geochronology. Lougee reckons the Leverett stability from near the Harbor Hill Moraine 16 000 B. P. until an iceborder Haverstraw-Middletown-Taunton, accordingly c:a 7 000—5 900 BZ, round 1 200 years, the Hubbard uplift perhaps 500 years and thus the De Geer Marine Stage from — 5 500 on for some 4 000 years. Its Scandinavian equivalent the Baltic Ice Lake may be reckoned from the bottom varve at Rörum (soon interrupted by a marine interval round S Scania, ending — 3 900 BZ) until the first eastern saltwater influx in — 1 715 = 2 630 years and with next saline stage in all 3 280 years, until in — 1 073 the Yoldia Sea took its place, here averagely parallelized with the Champlain Sea in America. Lack of bottom varves — difficult to attain — thereafter make American years diffuse.

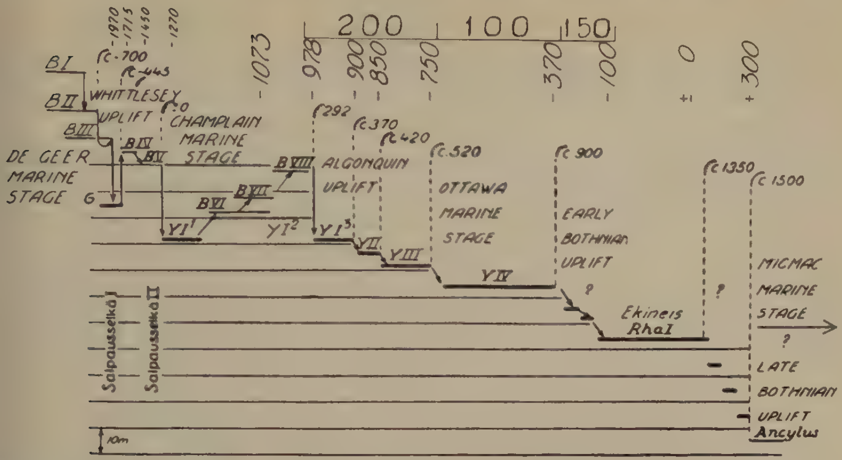


Fig. 2. Sauramo's dated scheme of the Fennoscandian uplift transdated to the De Geer chronology and synchronized with Lougee's main stages of stability and uplift. The De Geer marine stage embraces contemporaneous ice retreat through New England and the Baltic valley, while the Ottawa marine stage includes ice retreat through the Mattawa valley towards the Cochrane stage, which prevailed round about 7 000 B.P. in Micmac time, where also the Lake Algonquin later stages may be duly placed in accordance with the C 14 date No. 504, although this latter, 3 500 B.P., seems to be surprisingly late.

menon rather alien to the Swedish geologists. Here, instead, recent work on land elevation has resulted in finding the uplift of the Scandinavian peninsula to have proceeded very evenly (E. Nilsson 1953).

However, Professor M. Sauramo, Helsingfors, Finland, in 1942 presented a scheme of a somewhat similar kind, showing also for Fennoscandia a series of pulsations with zones of stability interrupted by stages of general uplift, forming a set of steps. His stages can be very closely dated, as following the varve-dated ice retreat, so precisely determined in these regions (fig. 2).

For America, a dating of Lougee's stages is accomplished thanks to the present development of De Geer's geochronology, as being plotted, in the Geochronologic Institute in Stockholm, with all varve measurements minutely correlated and also, by a thorough study of Dr Antevs' New England chronology, as also synchronized with this latter. This part of Dr Antevs' work is certainly very valuable, although a greater precision in its application should have been available but for his scarcity of series measured down to the substratum. A dozen of them, where Sweden has several scores, however here and there give a welcome possibility of fixing a dated ice-border on the map.

A table of synchronization is here presented mainly with the purpose of establishing the precise dates from De Geer's chronology and also the relative length of the Primo-, Dani-, Goti-, and Finiglacial stages, corroborated with Lougee's succession of crustal pulsations. A few bottomvarve determinations (or, in America, very nearly so) are put out apart.

Professor Lougee is certainly to congratulate for his reliable work, a chronology without years, something like the typological chronology of O. Montelius in the field of Archaeology. De Geer, after having determined the total rate of ice recession by a line of measurements along a radius of ice retreat, mainly applied his geochronology by so called marginal datings, which implies that any single individual measurement of some length, after its position in the system is duly considered, will be found to match its contemporary varves often equally well independently of distance. Several examples of this phenomenon will be shown as soon as time permits. This marginal or tangential scheme is quite logical, considering the globe's diurnal rotation round its axis, repeatedly exposing its entire surface to the everlasting irradiation from the sun. The globe, Tellus, thereby annihilates its terrestrial distances, and its relation to the sun is quite another affair.

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# Anmälanden och kritiker

PAUL WOLDSTEDT: Das Eiszeitalter. Grundlinien einer Geologie des Quartärs. Erster Band. Die allgemeinen Erscheinungen des Eiszeitalters. Zweite neu bearbeitete Auflage. Ferdinand Enke, Stuttgart, 1954. VII + 374 sid. 156 textfig. + 4 tab.

Den andra upplagan av Woldstedts stora översikt över istiden är uppdelad å två band, en delning som onekligen varit till fördel. Del 1, som nu föreligger tryck, ger en allmän översikt av kvartärgeologien och därmed samman-ängande företeelser. Del 2 kommer att behandla de olika nedisningsområdena ar för sig.

Även inom det första bandet har omdispositionen varit ganska genom-ripande. Det allmänna intrycket är, att denna upplaga blivit redigare än sin öregångare. Redan i inledningen märker man en avsevärd omarbetning. 1:a pplagans korta inledningskapitel har ersatts med en fylligare allmän över-ikt och begreppsutredning.

De nu existerande glaciärområdena behandlas därefter och utgående från e recenta bildningarna i dessa redogör förf. sedan för motsvarande från is-iden härstammande avlagringar — glaciala och periglaciala — samt för nterglacialavlagringar och erosionsformer. Vad beträffar de periglaciala fe-omenen, vilka under de senare åren tilldragit sig ett stigande intresse, får nan i denna upplaga en betydligt klarare överblick över dem än i den före-ående. Slutligen avhandlas de stora dragen av florans, faunans och män-iskans historia under pleistocentiden.

Givetvis har verket i många avseenden moderniserats — det är 25 år som kiljer de båda upplagorna åt. En del nyare litteratur har alltså tillkommit. ock synes den nordiska fortfarande vara alltför mycket förbisedd. Visser-igen är det kanske för tidigt att yttra sig härom innan man sett nästa band, en man saknar i alla fall en del litteratur, som väl rätteligen borde hört emma i band 1. Detta gäller t. ex. arbeten av principiell betydelse rörande ordarterna, deras sammansättning och egenskaper.

Illustrationsmaterialet har, vad beträffar kartorna moderniserats och i råga om övriga bilder något utökats — men tyvärr bitvis i stället minskats ed. Dock få vi kanske återse en del av de saknade bilderna i band 2.

Ett slutomdöme om detta viktiga verk kan knappast lämnas förrän det ndra bandet utkommit, vilket man får hoppas ej skall dröja alltför länge.

*Jan Lundqvist*

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H. & G. TERMIER: Formation des continents et progression de la vie. Masson & Cie, Paris, 1954. 132 sid., 4 textfig., 20 pl., 5 kartor, 1 tab. Pris 750 fr.

Titeln på detta populärvetenskapliga arbete täcker precis innehållet, lket kanske är en något originell kombination. Delar av särskilt kontinen-rnas historia behandlas ganska utförligt — t. ex. vissa bergartsbildande processer — medan man i övrigt saknar det mesta av standardinnehållet i verk av denna typ. Framställningen vittnar om ett friskt och originellt grepp om ämnet men lider av vissa brister, bl. a. i fråga om dispositionen. Ett vackert exempel på hur man icke skall åskådliggöra den geologiska tidsskalan lämnas även (sid. 8). I stället för att göra detta i tabellform räknas alla de olika perioderna upp i följd — med tidsangivelser. Illustrationsmaterialet är dock nästan genomgående av hög kvalitet och skiljer sig från det man vanligen ser. Fotografierna äro till stor del hämtade från Nordafrika — Algeriet — där författarna ha sin verksamhet.

Trots att arbetet sålunda är behäftat med en del svagheter kan man, när man ser det, inte låta bli att beklaga, att vi här i landet inte ha något modernt motsvarande verk, vilket kan ge allmänheten en populär uppfattning om vår jords geologiska utveckling och uppkomsten av de bergarter m. m., som v dagligen se omkring oss.

*Jan Lundqvist*

F. Trey und W. Legat: Einführung in die Untersuchung der Kristallgitter mit Röntgenstrahlen. Eine elementare Darleg ung der Methoden mit Aufgaben. 113 sid. Pris häftad 3 Springer Verlag, Wien 1954.

Boken ger en elementär framställning av röntgenstrålars diffraktion i 1-, 2- och 3-dimensionella punktgitter samt olika metoder för undersökning av kristallstrukturer. För att stimulera självverksamheten hos läsaren åtföljes framställningen av problem med lösningar.

Urvalet av undersökningsmetoder synes vara rätt ensidigt. Sålunda saknas exempelvis en redogörelse för Weissenberg-metoden, vilket får anses som en allvarlig brist med hänsyn till att framställningen grundar sig på reciproka gittret.

Då flera goda engelska läroböcker finnas, torde knappast detta bidrag till läroboksfloran ha något större intresse för studerande i vårt land.

*O. Gabrielson*

## Mötet den 4 november 1954

Närvarande 60 personer.

Ordföranden, hr Tamm, öppnade mötet och uttryckte sin glädje ver att Föreningen denna gång kunnat samlas på Skogshögskolan.

Styrelsen har till ledamöter i Föreningen invalt: Fil. Kand. Bengt Lindqvist, Uppsala, föreslagen av hr Collini samt Professor Lambert Viklander och Laborator Sigvard Andersson, båda vid Lantbruks-ögskolan i Uppsala, föreslagna av hr Hessland.

Hr O. Tamm höll ett föredrag om: Geologien i den högre kogliga utbildningen i Sverige.

Den högre skogsundervisningen i Sverige tog sin början i och med Kungl. Skogsinstitutets inrättande år 1828, främst tack vare energien ch framsyntheten hos hovjägmästare I. A. af Ström, som blev dess örste direktör. Undervisningen bestreds att börja med av denne och n biträdande lärare, vilken senare bl. a. hade mineralogien på sin lott. Om geologi talades ej vid denna tid. Småningom, omkring 1860, fick aturalhistoria en särskild lärare, som bl. a. hade att meddela under-isning i geologi. Snart förvandlades befattningen till ett lektorat i aturvetenskap med skogsbotanik som centralt ämne, varjämte en sär-kild lärare anställdes i zoologi; denne senare fick även geologien på in lott.

Förmedelst en genomgripande omorganisation förvandlades skogsin- titutet år 1915 till en högskola, skogshögskolan. Naturvetenskapernas tällning vid denna dikterades nu såsom tillförne av de praktiska skogs-ännen, d. v. s. jägmästarna. Därav kom sig, att man aldrig införde ågot nytt naturvetenskapligt ämne på schemat med mindre man kände, tt ämnet ifråga gjorde verklig nytta i den skogliga utbildningen. Flera mnen, vilka ej ansågos tillräckligt ha fyllt detta krav slopades vid morganisationen. Dessa allmänna synpunkter delades av den bekante äxtgeografen och geologen, professorn vid handelshögskolan i Stock- olm Gunnar Andersson, vilken var medlem av skogshögskolans styrelse ch i hög grad satte sin prägel på omorganisationen av år 1915. Under- isningen i geologi med mineralogi anförtroddes nu åt en speciallärare, edan den egentliga markläran förelästes av en annan sådan. Det var örsta gången geologien kom att representeras av en fackman. Ämnet ck 28 föreläsningstimmar, 9 övningstimmar och 4 exkursionsdagar.

I fortsättningen utnyttjades två exkursionsdagar till geologi, meda de övriga sammanslogos med exkursionerna i egentlig marklära (fyr dagar), vilka alltså leddes gemensamt av två lärare. I den ekonomisk efterkrigskrisen i början på tjugotalet indrogs emellertid geologiläraren deltagande i dessa gemensamma exkursioner.

Med insikt om geologiens stora betydelse för skogen enligt forskningsresultat av Halden, Malmström, Tamm m. fl. arbetade geologien representant på att införa fältövningar i geologi på skogshögskolan undervisningsschema. Detta lyckades i början på trettiotalet. Härefte fick varje student upprätta en geologisk karta med beskrivning av et långt och smalt skogsområde på c:a 30 ha. Vid en ny omorganisation a år 1949 utvidgades övningarna, bl. a. till följd av en uttalad önskan frå studentkåren.

För närvarande ingår geologien vid skogshögskolan som en mycke viktig del i ett komplext ämne: skoglig marklära (egentligen skogli ståndortslära). Den geologiska undervisningen är i huvudsak förlagd ti Garpenberg i södra Dalarna och omfattar inklusive mineralogi c:a 3 föreläsningar, c:a 15 övningstimmar inomhus (mineral- bergarts oc jordartskännedom) samt c:a 55 övningstimmar i fält (kartering). Därtill komma 10—12 dagars exkursioner och fältövningar i både södr och norra Sverige i geologi, kombinerad med egentlig marklära. Unde dessa senare fältarbeten eftersträvas att giva studenterna en helhetsbild av sammanhangen mellan vegetation, jordmånstyp, geologi hydrologi och klimat. Föreläsningarna i geologi behandla Sverige berggrund, lösa jordlager, ytformer med landskapstyper och i samban härmed det viktigaste av den allmänna geologien. Huvudvikt lägge städse vid sådant som har påtaglig betydelse för skogen. Härav följe att man ej kan uteslutande använda någon av de f. n. föreliggand läroböckerna. I stället ha stencilerade kompendier utgivits.

Geologens och skogsmannens yrken ha många beröringspunkter me varandra. Både geologer och skogsmän äro i regel födda med ett utpräglat sinne för naturiakttagelser. Det är ett av geologiundervisningen mål vid skogshögskolan att söka utvidga och utveckla de blivand skogsmännens iakttagelseförmåga till att omfatta även den geologisk faktorn i skogsbruket, varigenom skogsskötseln bör kunna uppnå e förbättring i precision och ändamålsenlighet till fromma för vårt land ekonomiska liv.

Hr T. Troedsson höll ett av ljusbilder belyst föredrag om Grundvattnets uppkomst och kemiska sammansättning. Studier med särskild hänsyn till förhållandena i skogsmarke

Undersökningarna ha i huvudsak omfattat detaljstudier över ytvattnets, sjunkvattnets och grundvattnets egenskaper i skogsmarken. Med utgångspunkt från grundvattnets kemiska sammansättning inom geologiskt olika miljö har det kunnat påvisas att de nämnda vattenfraktionerna mycket snabbt uppnå en jonbytesjämvikt med omgivande kolloidpartiklar. Denna jonbytesjämvikt påverkas för grundvattnets del ej nämnvärt av torrperioder, tjälning etc. Med hjälp av lysimetrar, perkoleringsförsök, pressningar etc. har sjunkvattnet uppsamlats och analyserats. Katjonhalterna i sjunkvattnet har därvid visat sig vara betydligt större än i yt- och grundvattnet. De sistnämnda vattenslagen äro däremot vanligen mycket lika varandra i sin kemiska sammansättning.

På laboratoriet har föredr. funnit att sjunkvattnet perkolerar på »bred front» först då jordarten, t. ex. en sandig-moig morän, är mättad med fuktighet till c:a 1/3 av dess totala vattenkapacitet. Genom mätningar i fältet under hela år har det visat sig, att denna fuktighetshalt sällan uppnås på 1—1,5 m:s djup i ett medelålders barrblandbestånd på sandig-moig morän, där grundvattenytan ligger på 2—2,5 m:s djup och där bottenvegetationen utgöres av husmossor. Urlakningen i marken är alltså en process med helt svag intensitet. Ävenledes ha klorhaltsbestämningar skett på olika djup inom områden, där jordmånshorisonterna praktiskt taget ej kommit till utbildning. Resultaten från dessa undersökningar framvisa även en långsam urlakning. Lysimeterförsöken visade att blott några få procent av den årliga nederbörden når ned till 1,0 m:s djup inom skogsbestånd av ovan angiven typ.

Gödslingsförsök på grov sand visade även för vissa katjoner hän på en mycket långsam urlakning, vilket till stor del måste bero på de olika jonslagens kemiska fastläggning i jorden. På grundval av bl. a. alla dessa försöksresultat hävdade föredr. att »bredfronts-perkoleringen» i nämnda skogsmark måste till övervägande del betraktas som en diffusionsprocess. Blott en mycket ringa del, om ens något, av nederbörden förmår tränga ned till grundvattnet genom verklig bredfronts-perkolering. Likheten i yt- och grundvattnet får tolkas som att ytvattnet snabbt når grundvattnet genom rotkanaler, sprickor (åderdränering), utmed hällar etc. Såsom stöd för dessa antaganden ha tydliga humusämnesskikt (hårda, tunna krustor) kunnat iakttagas utmed hällar, där av allt att döma infiltrationen av nederbördsvattnet är stor. Dessa humusämnesskikt behöva ej vara uthålliga på själva hällytan, utan så snart en packad bottenmorän, eller t. o. m. en svagt svallad morän tillstöter fortsätter vattnets infiltration (och därmed även humusämnesskiktet), nu ovanpå dessa jordarter. Dessa skikt bestodo i huvudsak av organiskt material och kvarts. Övriga mineral ha i huvudsak bortlösts genom kemisk vittring, som i dylika lager visats vara intensiv. Vid ingående studier över vattnets rörelse i marken har föredr. också påvisat att ytavrinningen omedelbart under humustäcket på den svallade eller svagt svallade moränen är betydande. Likaså är ytavrinningen i svallgruset ovanpå den osvallade moränen av stor omfattning. Såvida hällprocenten inom ett område är hög (d. v. s. 20—25 % av den totala skogsarealen) kan hällmarken svara för en avrinning till vattendragen, som är nästan lika stor som den vilken kommer från den övriga, skogbevuxna ytan. Inom områden, där hällprocenten är låg, blir ytavrinningen på den osvallade (el. motsv.) moränen vanligen av mycket stor omfattning i vår vanligen tämligen starkt kuperade terräng.

Som ett huvudresultat av undersökningarna gäller sålunda att perkoleringen på bred front i »normal» skogsmark är tämligen liten. Detta innebär att en ev. gödsling i skogsmarken kan inom plana områden ur urlakningssynpunkt anses bli ekonomisk; vidare bör podsoleringsförloppet vara starkt beroende av den årliga nederbördens nedträngningsförmåga i marken. Som praktiskt skogliga resultat bör även framhållas, att i sluttningar med översilande vatten är näringsutbudet av betydelse för boniteten och inom dylika sluttningar torde all skogsdikning böra ske med största försiktighet.

Försöksområdena för dessa undersökningar ha i huvudsak varit spridda i södra och mellersta Sverige med ett fåtal försök förlagda till Norrland. Huvudförsöksområdet har legat i Bjurfors kronopark invid Avesta. En redogörelse för samtliga försök och de därvid erhållna resultaten är under tryckning i Skogshögskolans skrifter.

Med anledning av föredraget yttrade sig hrr Ekström, Wiklander, Halden, docent C. O. Tamm, J. Eklund, S. Andersson, Rengmark, G. Troedsson och föredragshållaren.

Efter diskussionen visades Skogshögskolans institution för marklära med geologi.

Vid mötet utdelades N:o 478 av Förhandlingarna.

# Mötet den 2 december 1954

Närvarande 60 personer.

Ordföranden, hr Tamm, öppnade mötet med följande anförande:

Sedan föregående möte har Föreningens ledamot, Förste byråingeniören Carl-Arvid Landegren avlidit i en ålder av 58 år. Han var född i Väderstad, Östergötland och avlade 1921 bergsingenjörsexamen vid Tekniska Högskolan. Efter flerårig verkamhet vid olika företag här och i utlandet kom han 1945 till Kommerskollegium och blev följande år förste byråingenjör och föreståndare för gruvkartekontoret. Under många år har han drivit egen konsulterande rörelse. Han var ledamot av Geologiska Föreningen sedan 1948.

Jag lyser frid över den bortgångnes minne.

Styrelsen har till ledamot i Föreningen invalt Fil. Mag. Erkki V. Heiskanen, Loubi, Finland, föreslagen av hr T. Eriksson.

Styrelsen har konfererat med chefen för Sveriges Geologiska Undersökning, hr N. H. Magnusson, om anordnande av ett Nordiskt Geologmöte i Sverige i samband med Sveriges Geologiska Undersöknings 100-årsjubileum 1958. Hr Magnusson har lovat, att vid något av Föreningens möten instundande vår närmare framlägga planerna för Geologmötet.

Förrättades val av styrelse och revisorer för år 1955, varvid utsågos:
till ordförande hr C.-G. Wenner,
till sekreterare hr E. Åhman,
till redaktör för Förhandlingarna hr R. Sandegren,
till skattmästare hr O. Gabrielson,
till övriga ledamöter av styrelsen hrr B. Collini och E. Fromm.

Till revisorer att granska 1954 års förvaltning utsågos hrr P. H. Lundegårdh och J. Lundqvist med hr B. Dahlman som suppleant.

Föredrag hölls om Intryck från Nordiska Geologmötet i Finland 1954. Hr P. H. Lundegårdh talade om urberget, hr T. Eriksson om malmerna och hr E. Fromm om kvartären. Föredragen illustrerades av talrika ljusbilder.

Med anledning av föredragen yttrade sig hrr N. H. Magnusson, Norrgård, Fromm, Gavelin, Sandegren och Rengmark.

## Geolognytt

Föreståndaren vid Palynologiska laboratoriet, Bromma, fil. dr Gunnar Erdtman har av Kungl. Maj:t tilldelats professors namn.

Statens naturvetenskapliga forskningsråd har tillsatt en kommitté för palynologi. Kommittén består av följande medlemmar: professorerna F Fagerlind (ordf.), R. Florin, J. A. Nannfeldt och G. Erdtman samt statsgeologen G. Lundqvist. The Rockefeller Foundation, New York, har tilldelat Forskningsrådet ett anslag på 12 000 kr för inköp av litteratur och annan utrustning till Palynologiska laboratoriet i Bromma.

Kungl. Vetenskapsakademien har från Ahlstrandska fonden och Regnells zoologiska gåvomedel tilldelat docenten Gerhard Regnéll, Lund, 500 kr.

Statens Naturvetenskapliga Forskningsråd har utdelat bl. a. följande anslag: prof. G. Erdtman, Bromma, 5 700 kr. för elektronmikroskopiska studier av pollen och sporväggar; prof. S. Hjelmqvist, Lund, 2 000 kr. för resa till Mellanitalien för jämförande fältstudier inom recenta vulkanområden samt insamling av material; fil. lic. C. G. Holdar, Stuvsta, 3 000 kr. för undersökning av isavsmältningsförloppet i Sveriges nordligaste fjälltrakter efter senaste nedisningen; agronom E. Lotse, Uppsala, 2 500 kr. för undersökning av jordmånsbildningen i odlad mark; laborator T. Nilsson, Lund, 3 000 kr. för pollenanalytisk bearbetning av provserier från Ageröds mosse i Skåne.

# INNEHÅLLSFÖRTECKNING.

*Anm.* U efter titeln utmärker uppsats.
N » » » notis.
RF » » » referat av hållet föredrag.
F » » » hållet föredrag.

**Författarna äro ensamma ansvariga för sina uppsatsers vetenskapliga innehåll.**

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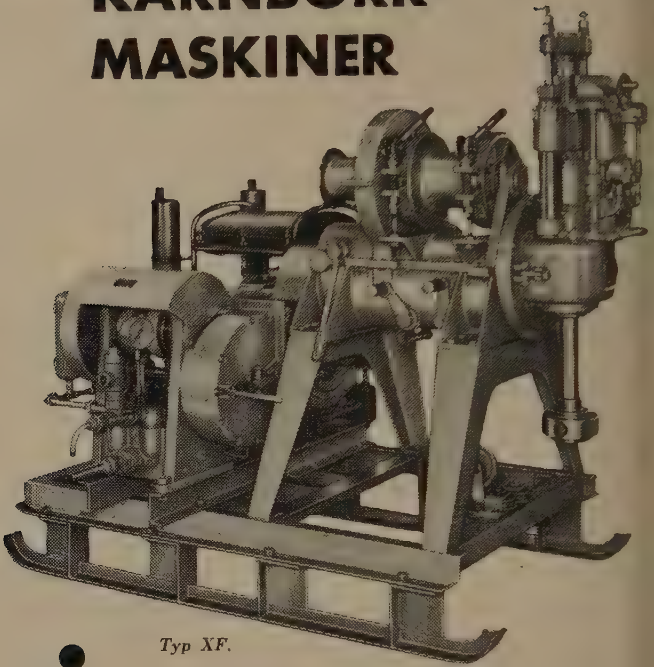

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